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Inquiry into the Best Mode of Supplying
Boston with Water - 1845

I N Q U I R Y
INTO THE
BEST MODE OF SUPPLYING
THE CITY OF BOSTON,
WITH
W A T E R ,
FOR DOMESTIC PURPOSES,
IN REPLY TO THE
PAMPHLETS OF MR. WILKINS AND MR. SHATTUCK,
AND ALSO TO SOME OF THE
REPRESENTATIONS
TO THE COMMITTEE OF THE LEGISLATURE,
ON THE HEARING OF THE
PETITION OF THE CITY.

BY A
MEMBER OF THE LATE BOARD OF WATER COMMISSIONERS.

BOSTON:
1845.
EASTBURN'S PRESS

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Sept 4, 1934

INQUIRY

INTO THE BEST MODE OF SUPPLYING THE CITY OF BOSTON WITH WATER
FOR DOMESTIC PURPOSES.

THE objections which have been made, to the mode of supplying the City with water, recommended by the late Board of Commissioners, seem to call for a reply from some one conversant with the grounds on which this recommendation was made. The proposed method of supply has been assailed with an earnestness which seems to imply a conviction, that it would not stand the test of examination, yet so far as the writer of these remarks can discover, not one of the facts on which it rests, has been shaken. The writer believes therefore, that it will be easy to show that all the objections to it are founded in error, and that the assailants have acted under mistaken opinions, taken up with very little consideration at first, and persevered in, because they found them echoed, in the responses of persons who have an interest in other modes of supply. We should not speak with this confidence, if we could find any thing like proof or authority, in support of opinions which are placed in opposition to the estimates of the Commissioners. For example; it is assumed as a matter of fact, though unsupported by the least evidence, or even a plausible calculation, that the cost of the work recommended will be twice the amount of the estimate; and also, with a similar absence of proof, founded on experience in any analagous case, that a quantity of water, not equal to a third part of that which the Commissioners believe should be provided for, is all that is needed. These and certain other allegations it is proposed to submit in the course of the following remarks, to the test of examination.

The writer of these pages does not enter upon the subject, as one presenting merely questions of curious speculation, or from any love of controversy; but he undertakes the inquiry from a sense of duty, as one involving a question of great practical importance to the welfare of the City, and to the comfort of its inhabitants. It is of great moment that there should be no mistake on a question of so much importance. Should the City engage in the erection of works of this magnitude, which shall prove inadequate to their object, or should the water introduced prove unsuited, from the want of the greatest attainable degree of purity, for the purposes of food, and all other domestic uses, it will be a most serious error, which it will be extremely difficult, if not impossible, to correct.

The direct object of these remarks is, to vindicate the general principles of the report of the Commissioners lately appointed under an order of the City Council, "to report the best mode, and the expense of bringing the water of Long Pond into the City of Boston," in reply to the principal objections brought forward in the publications of Mr. Wilkins and Mr. Shattuck, and also by the witnesses who were called to testify before the Legislative Committee, in support of the remonstrance against the petition of the city, for authority to introduce the water of Long Pond for the supply of the inhabitants. These objections will not be all taken up separately, and replied to in form, but an attempt will be made, to defend the general principles and substantial positions assumed in the report, and to refute the principal allegations and reasonings in opposition to it.

1. *The necessity of a supply of pure and soft water for the City.*

The first inquiry which it is proper to make, regards the necessity of any supply of water for the domestic uses of the inhabitants of the City, and the amount of supply which is adequate to meet their wants. With this inquiry is connected the question, whether the supply should be obtained at the expense of the City in its

municipal capacity, or in any other mode. That there is a want of water in the City to a certain extent, is admitted by the authors of both the pamphlets above quoted, but they limit the demand to an insignificant quantity, compared with that proposed by the Commissioners to be introduced. By this limitation of the required quantity, they attempt to find an argument for an entire change of the proposed mode of supply. Mr. Wilkins distinctly admits the necessity and expediency of a supply, in the following terms.

"I am entirely satisfied that the City of Boston ought to have a copious supply of good water from a foreign source; that on the whole this supply should be introduced by the City Government; and I am inclined to take one step further, a step not proposed to be taken by those who have been most zealous in pressing forward the project, namely, to distribute the water for domestic purposes, free from charge."

So far therefore as regards the necessity of a further supply of good water, to a certain extent, and indeed what he terms "a copious supply," and the expediency of obtaining this supply at the cost of the City, Mr. Wilkins concurs fully with the opinion of the Commissioners, and with that of the petitioners. The last proposition here stated by Mr. Wilkins, is one from which the writer of this feels bound to dissent, as a measure in his opinion highly inexpedient, on several grounds. First, because he cannot perceive the reasonableness or propriety of providing such a necessary of life, at the public charge, except to the poor. It is what no community has ever done, and it is difficult to imagine why the citizens of Boston should adopt an experiment of this sort, at variance from the usage of every municipal community in the State, and in the country. It is an experiment which would at any rate be burdensome to the City Treasury, and might lead to very serious consequences, in the precedent thus established. If the property of the citizens is to be taxed for the supply of water, to be furnished without remuneration, to those who are able to pay for it, why not adopt the same expedient for the supply of fuel, light and every other ne-

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1. The necessity of a supply of pure water for the City.

The first inquiry, which is proposed, is, whether the necessity of any supply of water for the uses of the inhabitants of the City, which is inadequate to the supply which is connected with this inquiry is connected with the supply should be obtained from the City.

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cessary of life? In the second place, to adopt the expedient would lead to irremediable waste. How, in furnishing the water on such a principle, could the supply be limited to the actual wants of the citizens demanding it? Instead of seven millions of gallons for the supply of 200,000 or 250,000 inhabitants, it could hardly be expected to suffice for half that number. Yet Mr. Wilkins is of opinion that 1,820,000 is all that need be provided for 120,000 inhabitants. We do not dwell upon this question, for we believe there are few who concur in the opinion above expressed: We have briefly alluded to it here, because it seemed hardly proper to suffer so important a suggestion, from so respectable a source, to pass without remark, at a moment when it is necessarily brought to attention.

2. The expediency of introducing the supply at the expense of the City.

The propriety and expediency of introducing and distributing the water at the public charge, on the condition that it shall be paid for by those who use it, rest upon entirely different principles. In the first place the water cannot be introduced at all by individuals, each for his own use, nor even by companies, except by concert with the municipal authorities, in the regulation of the distribution, which cannot be made but by frequent obstructions of the streets, and disturbance of the pavements. This renders it desirable, that the distribution should be exclusively under municipal regulation. But a more important reason, why it should be introduced at the public charge is, that otherwise a monopoly must be given to a private company, with the power of making a profit, which it would be impracticable to place under satisfactory legal restrictions. The whole supply, or at least that of particular sections of the City, must almost necessarily depend upon a single company. There can of course be no competition to afford security against excessive charges. In certain parts of London, separate companies have their pipes running through the same streets, interlocking one another, and causing

great inconvenience both to one another, and to the public. No such multiplication of water pipes, in addition to gas pipes and sewers, could with propriety be tolerated in our streets. But if it were practicable to obtain an adequate supply in every part of the City, from a single company, at a cost which would afford the proprietors but a reasonable profit for the risk they would incur, it is extremely desirable from the universality of the demand, for the use of citizens of all conditions, that it should be supplied at a charge not far exceeding the actual cost. It is an enterprise in which every citizen has an interest, and there is a manifest propriety in undertaking it in a manner, in which every one shall share in the benefit, on paying as nearly as it can be assessed, his share in the cost. If the water can be furnished, as in the City of Philadelphia, in a quantity which is abundant, and delivered under a head which will carry it to any part of every house, at a cost averaging about \$6 to each family supplied, it is surely an object deserving of being purchased at the risk of a trifling loss to the City Treasury, rather than that all should submit to a charge of \$12 or \$15 to each family, for a limited supply, delivered in a large proportion of cases only in the cellars of those who receive it, could it even be obtained at that cost.

In confirmation of this reasoning, we quote the following passage from the testimony of Thomas Clarke, Esq., M. D. Professor of Chemistry in the University of Aberdeen, given in the course of a parliamentary investigation to which we shall hereafter more particularly refer. He was called on for information on account of his great experience in matters relating to the supply of towns with water, and his opinions are deserving of particular attention, as the result of much observation, and careful reflection.

"Living in a town with a population of nearly 70,000 inhabitants where the water is supplied, not by a joint stock company, but by the Commissioners of Police, who are elected by the rate payers, it has often occurred to me to question the policy of allowing water to be supplied to a town by a joint

stock company in any case whatsoever. The extensive pipes laid throughout all the streets, and branching to most of the houses, cannot conveniently, nor without a great sacrifice of expense, be laid in a second set, much less in a third; therefore competition, such as occurs in the supply of bread and meat, or of like articles of demand, is out of the question in regard to the supply of water on a large scale. The establishing of a joint stock company for the supply of a town with water is the establishing of a monopoly of trading persons having the power, without responsibility, of taxing the inhabitants for their own benefit. The practical check on any crying excess in their charge and on their heedlessness about supplying water of a proper quality, lies mainly in the apprehension of a second company being established; but since no new works can be established without an act of Parliament, and without risk of competition with the old company, such as almost always proves ruinous to both; and since, in order to establish the new company, an agitation in the community has to take place, the check is not of a desirable kind; neither is it effectual in the generality of cases. There is no town that I know supplied with so good water as Aberdeen, or having the supply managed in a more satisfactory manner."

3. Mr. Shattuck's views of the necessity of a further supply.

Mr. Shattuck's views on the points embraced in the above extract, differ widely from those expressed by Mr. Wilkins. In reply to the inquiry, "Is there a necessity for the introduction of water from a foreign source," he gives the following rather enigmatical answer.

"There undoubtedly exists a necessity, or at least a strong desire among many inhabitants of Boston, for a supply of water from a foreign source. That the extent of this necessity, however, has been much over-estimated, is a truth, which in my judgment may be clearly demonstrated. Cases of inconvenience, and even temporary suffering for water may exist in Boston, and many would no doubt exist if water was brought in, unless it was made free to every one, and even carried into their houses gratis. Some persons are so negligent as not to keep their pumps in order, and neither landlord nor tenant would incur much trouble or expense in bringing the water from the main pipe in the street into their houses, nor keep the apparatus in order if brought in. Such

cases should not be relied upon to prove a general want of water. The late vote of this City was given on the express condition that all the water should be paid for; if this restriction is enforced, how are the destitute made so by negligence or poverty, to be furnished? Will not cases of want still exist?"

This is a most unsatisfactory description of the demand, for a further supply of water in this City. It surely cannot be seriously pretended, that the cases of inconvenience and suffering for want of water, arise chiefly, or in any considerable degree, from the negligence of landlords or tenants, in keeping their pumps in order, or that the want is confined principally, or in any degree to a class of people who would not submit to the expense and trouble of obtaining water from the pipes, if they passed through the streets. Mr. Shattuck must be greatly mistaken as to the condition and circumstances of the 7,000 citizens, who voted to instruct the City Council, and the members of the Legislature, to use their exertions in favor of the introduction of water, at the expense of the City. He says that the extent of the necessity for more water has been "over-estimated," but he does not inform us by whom this over-estimate is made. In his attempt to limit the existing want to those who are too negligent of their own interests, or too poor to be benefited by a supply if introduced at the public expense, unless they are supplied with it gratis, we think he has fallen into a great error. If we could believe this representation, and that "neither landlord nor tenant would incur much trouble or expense in bringing the water from the main pipe in the street into their houses, nor keep the apparatus in order if brought in," we should certainly be of his opinion that it would be a very superfluous expense on the part of the City to undertake to furnish a supply. But knowing as we do that an entire want of water suitable for domestic uses is severely felt, not merely by those who cannot afford the expense of keeping a stop-cock in repair, but by thousands of families who are able and willing to pay for every thing which is necessary for their

comfortable subsistence, we have formed a very different judgment of the necessity of a supply from abroad. This necessity does not arise from the negligence of the sufferers in not keeping their pumps in order, but from the fact that they have no pumps, and can have none, by which it would be possible for them to obtain water fit for use. The deficiency does not arise from the neglect, indifference, or inability of those who are in want to supply themselves, if the means of doing so were at hand at a moderate cost.

4. *The present mode of supply.*

In a certain way the absolute wants of the inhabitants of the City are supplied. They could not subsist without it. But in obtaining this subsistence they are subjected to great and unnecessary inconvenience, varying greatly, according to the situation of different families. There are many wells in the City which afford a clear, apparently pure, and palatable water. All this water however is found on a chemical analysis, to contain in combination various saline substances, in a much larger proportion than the Pond water, which is proposed to be introduced as a substitute for it. There is not a well in the City which affords what can be properly denominated *pure soft water*. There are many wells which formerly afforded a comparatively pure, palatable water, the springs of which are now supplied in part by filtration through privies, vaults, grave yards, common sewers, and other receptacles of the most impure substances, and are consequently rendered unfit for use. There are persons so situated, that they can provide themselves with wells only at the hazard of robbing the wells of their neighbors. There are others who by digging a well obtain only water so brackish that it is unfit for use. There are still others who can resort only to the expedient of sinking Artesian wells, to a depth of 100 to 140 feet, at an expense of from \$600 to \$1000, and at the hazard of obtaining no water, or that which is unfit for use. The Boston and Worcester Railroad has been at an expense of more than

\$2000 in sinking two Artesian wells, one of which is entirely useless, and the water of the other is unfit for use in locomotive engines, though it is valuable for certain other purposes.

Loammi Baldwin, Esq. in making his report to the City Council in 1834, finding that no accurate information could be obtained of the number of wells, and of the quality of the water, without a special inquiry made under his direction, employed Mr. Ebenezer A. Lester, to make a careful investigation of the number of wells in the City, to "collect all facts from the owners or occupants, as to the character, quality, and uses of the water taken from them, in every street, and to make a table shewing the number with the peculiar kind of water they furnished for domestic use." "The result of his researches," Mr. Baldwin remarks, "is very curious and his report is full, with a table showing in detail all the wells, distributed into seven different classes."

The following is an abstract of this table, as published in Mr. Baldwin's report.

" Whole number of wells,	-	-	2,767
Water drinkable in,	-	2085	
" bad,	-	682	
		<hr/>	2,767
" hard, not used for washing,	-	2760	
" soft, occasionally used for washing,	-	7	
		<hr/>	2,767
" fail,	-	427	
" injured by vaults, drains, or are nuisances,	-	62	
" brackish, bad, tolerable or turbid, but drank,	-	134	
		<hr/>	680
Bored, or Artesian wells, included in the above,	-	33	
Wells at distilleries,	-	18	
		<hr/>	51"

The number of wells in the City, particularly of Artesian, has been increased since the date of the above report. Many which were tolerable have become bad,

and many have been drained by deeper wells in the vicinity. The water of the Artesian well of the United States Hotel, according to the analysis of Dr. C. T. Jackson, contains in 100,000 parts, 114 of various kinds of salts and other solid matter; that of the well in use by the Boston and Worcester Railroad, 78 earthy parts in 100,000; the water of Long Pond, 6 parts in 100,000, and one other specimen analysed by Mr. Hayes, 3.03 parts in 100,000.

Not merely families which are destitute of well water, but all those who reside in the most favorable situations and have the best wells in the City, are obliged to rely upon *rain water*, gathered and preserved in cisterns, for washing, and for all purposes for which soft water is required. This resource is necessarily precarious; from the limited space which each family can rely upon for obtaining a supply, and from the occasional long intervals in which there is no rain. It is well known that in every dry season, many families expend considerable sums for the carting of water needed by them for domestic purposes. It is well known also that it is impossible, in consequence of the liability of the roofs in the City to be covered with soot and cinders, to gather rain water in a state of purity, but all of it so gathered is more or less colored, and impregnated with a sooty taste.

But admitting that every housekeeper in the City could be provided with an ample supply of these two descriptions of water, each the best of their kind which the City can afford, (a contingency which falls to the lot of but a limited proportion) with what propriety could it be said that there is no want of water from abroad? To say nothing of the quantity of salts of different kinds, which every person drinks, and the infusion of soot in which he daily washes himself, it is a far more costly mode of supplying each family, than that of introducing water by an aqueduct. The average cost of a well or cistern, if the latter be built of durable materials, with the necessary pumps, can hardly be less than \$150; besides which, there is the cost of repair of

pumps, and the cost or labor of pumping. It is true those who have already incurred the expenses of providing themselves with wells and durable cisterns will not have that expenditure refunded to them, on being furnished with a substitute for those unsatisfactory modes of supply. But they will still make a saving, not only in the improved quality, and greater abundance of the new supply, but in having no fixtures, except a stop-cock, to keep in repair, and in being spared the labor of raising the water by a laborious process from the well and cistern. Many farmers in every part of the country, even of moderate means, voluntarily submit to the expense of bringing water from a distant spring, for the sole purpose of saving the labor of drawing it from a deep well near at hand. When this advantage may be obtained, together with that of substituting the pure and soft water of Long Pond, for that of ordinary Boston wells and cisterns, it is not to be credited, that many persons will hesitate to avail themselves of the privilege, at the moderate cost at which it will be furnished, should a sufficient supply be introduced from Long Pond, and distributed in the manner proposed.

5. *Mr. Shattuck's estimate of the deficiency, and Jamaica Pond Aqueduct.*

Although Mr. Shattuck in the passage of his pamphlet above quoted, appears to limit the present suffering and inconvenience from a deficiency of water, chiefly to a class of persons who would not pay for it, if it were introduced at the city charge, he proceeds to make some statements and calculations, in which he admits a deficiency to a somewhat larger extent than would be inferred from the remarks above quoted. He undertakes to show, however, that 1,050,000 gallons is sufficient for the supply of the whole City, with the exception of that part which is, or may be, supplied by that of Jamaica Pond Aqueduct. After quoting some statements from a report of Mr. Loammi Baldwin, relating to certain additions which might be made to the supply from Jamaica Pond, but which have never yet

been made, although he computed that the supply might be thereby increased to from 500,000 to 700,000 gallons daily, Mr. Shattuck proceeds to remark :

" These facts being considered, I suppose it will be admitted by all who look candidly at this subject, that that part of the City proper lying south of a line drawn through Boylston and Essex streets, including wards ten and eleven and a part of ward nine, between Essex and Beach streets, is now supplied with pure water by wells, and by the Jamaica Pond Corporation; and may continue to be supplied for the next twenty or more years."

He thinks also, that the water of Jamaica Pond, as now furnished, " is cheaper than could be afforded by the City, if introduced as proposed, will be made apparent in the course of these remarks."

We cannot by any means admit the correctness of either of these positions. The quantity of water afforded by this aqueduct, instead of 500,000 to 700,000 gallons per day, is but 200,000. It is entirely inadequate to such a supply as is necessary either for the security of the City from fire, or for the convenience of families. The great insufficiency of water in that district as a resource for extinguishing fires, was conclusively proved on the occasion of the late fire in Dover street.

The 200,000 gallons of water per day, supplied by Jamaica Pond, although of a very good quality and of great utility to those parts of the City to which the level of the source admits of its being carried, are inadequate to a full supply of a single ward. Besides being insufficient in quantity, it cannot be brought even as high as the Tremont House. We learn from Mr. Baldwin's Report, quoted by Mr. Shattuck, that the highest point to which it can be brought in the central parts of the City, is the cellar of Mr. Wales's house in Winter street. If there were no deficiency in quantity, a supply which can be only introduced into a cistern at the bottom of a cellar, and which can be afforded only at the price of \$12 for an ordinary family, is far from such a supply as the interest and convenience of the citizens demands.

Mr. Shattuck assuming that South Boston will be content with its present supply of well water, and that wards ten and eleven, with part of nine, are already supplied by the Jamaica Pond Aqueduct, goes into an elaborate argument to prove that the remaining eight wards have already attained to nearly their maximum of population, and that they can never contain more than 80,000 inhabitants. Having demonstrated this to his own satisfaction, he goes on to argue that not one half these would take "pond water," if introduced, and after making what he supposes to be a most liberal allowance for all families now existing, or which may exist, "at some distant, future period," he comes to the conclusion above stated, that "averaging all that may be wanted for fires, streets, manufactories and all other purposes, will require the introduction into the City of only 1,050,000 gallons daily; not half what Spot Pond or one engine from Charles River would furnish."

The course of reasoning by which Mr. Shattuck satisfies himself that 6000 is the highest number of families which it will ever be necessary to provide water for, and that 1,050,000 gallons daily is, "in the largest sense," a very liberal supply for this number, including all which may be wanted for fires, streets, manufactories, and all other purposes, at any future day, is a little amusing. He begins with a population, according to the census of 1840, of 93,383. From this we are to deduct 8,383 for a mistake in the census. Then we deduct the population of ward 12, because, as far as Mr. Shattuck can learn, "no strong desire exists there, that the City should incur a large debt to supply what they do not generally want." Next we are to deduct wards 10 and 11, and one third of ward 9, because they are already supplied by 200,000 gallons of water per day from Jamaica Pond. We are to deduct also one third of ward 4, because the water cannot be carried to East Boston. In the mean time, there has been an increase of 22,000 since the date of the last census, but 11,900 of these are to be placed "in the supplied section." This leaves a population of 69,200 only to be

supplied. As to the future increase of the City, it must be chiefly south of Essex and Boylston streets, or at East Boston. The utmost increase of the other parts of the City, Mr. Shattuck thinks cannot raise their population over 80,000. Then if every family living in that section shall average ten each, (a pretty extravagant supposition) "it may fairly be presumed," Mr. Shattuck says, "that there never will be more than 8000 water takers." Of these not one half, in his opinion, will take and pay for the proposed water, but for argument sake he admits that three out of four may take it. "Then," he concludes, "we have 6000 *as the highest number of families that it will ever be necessary to provide water for* in that, and the only section of the City which may need a supply." Then allowing 175 gallons of water to each of these families of ten persons, we have the quantity above stated of 1,050,000 gallons of water per day, as the maximum supply to be required at any future day. Such is the reasoning by which we are to be persuaded that a million of gallons will be sufficient, not only for the present population, but for the future increase of the City, in the face of positive proof in the last Report of the Philadelphia Water Committee, that a City of less population, and of similar habits of living, now affords three times the number of "water takers," and that they require a daily supply of four times that amount of water through the year, and five times the amount through the summer season. Is reasoning like this to be relied upon, against the evidence drawn from facts in a parallel case?

6. *Mr. Wilkins's estimate of a supply for Boston.*

Mr. Wilkins makes a little more liberal estimate of the prospective demand for water, though he seems to think that our people will require rather a long period of education, before they will become accustomed to the use of it. Ten gallons a day each, for 120,000 inhabitants, he thinks will be a liberal allowance to begin with; but in 10 years the population may increase to 160,000, and the demand for water to 16 gallons each, making

2,560,000 gallons per day. Even this last is a very stinted estimate, as we shall endeavor to show. We think it very certain that the supply cannot be limited to this quantity, unless inconvenient restrictions are placed upon the use of the water by a rigid system of regulations, or unless a very high price is charged for it. Neither of these courses of proceeding can be consistent with the policy of the City in introducing it, for the very object in view is to obtain an ample supply, at a moderate and reasonable cost. Mr. Wilkins does not cite any authority in support of the opinion that the quantity named by him will be an adequate supply. It is doubtless impracticable to determine with precision what quantity will be required for the convenience of the public. The scale of supply, if the works be undertaken at the public expense, should undoubtedly be large enough to meet the largest demand, for which an adequate compensation will be voluntarily paid. There are few instances in large cities in which an attempt has been made to afford such a supply.

7. Water Works of Philadelphia.

The City of Philadelphia, however, affords an example exactly analagous, in the circumstances of the population, and the proposed mode of supply, to the case under consideration. The Commissioners of 1837 therefore adopted the quantity supplied to the inhabitants of that city, as the basis of their calculations. The quantity which has been since demanded for the supply of that population has been somewhat increased. Any person who will visit the City of Philadelphia, and observe the mode in which the water is used—the great convenience and economy of having an abundant supply always at hand to be drawn from the pipe at pleasure, without the expense of a cistern, or any other receptacle for containing it, before it is wanted for actual use—the degree in which this abundance of supply contributes to cleanliness, comfort, health, and security from fire—the multiplicity of its uses, not merely for domestic purposes but for various mechanical operations, in which perhaps

a quantity of water is used equal to that demanded in families, will be satisfied that the supply there is not superfluous, and that no part of it could be cut off, without a material sacrifice to many of those who use it, and a vexatious system of restriction, which would probably be productive of more expense than would be compensated by the saving.

This supply is afforded by the celebrated Fairmount Works, which were established at the expense of the city, on the present plan, in the year 1819, for pumping water from the Schuylkill river, to a reservoir, or rather several reservoirs on Fairmount, from which it is distributed by iron pipes to every part of the city, and to a part of the adjoining districts. The pumping is done by water power, derived from the fall of the whole of the water of the Schuylkill river, with the exception of what is required for the service of the boats of a navigable canal, it being raised 12 feet by a dam 1200 feet in length, forming a basin which extends up the river a distance of six miles. The water power is deemed sufficient in the driest season to raise to the reservoir ten millions of gallons per day, by eight wheels and pumps, 40 gallons of water upon the wheel being required, to raise one gallon to the reservoir. There are four reservoirs, of an area of more than six acres, twelve and a quarter feet deep, and containing, when full, upwards of 22,000,000 of gallons. The level of the surface is 102 feet above the tide water. The water is distributed from these reservoirs through iron pipes of various dimensions, measuring $66\frac{1}{2}$ miles in length in the city, and $54\frac{1}{4}$ in the districts. The pipes in the districts are laid at the expense of the respective districts, and the water has been hitherto provided to them, under special contracts, the tenants having been heretofore charged rents higher by 50 per cent. than the same classes of tenants in the city. The contracts with the three Northern districts, expired on the 31st of December last, those districts having united in constructing works for pumping water from the Schuylkill by steam power, to a reservoir of their own about a mile distant from Fairmount. From

this new reservoir water is now conveyed to the pipes of those three districts, measuring $38\frac{1}{4}$ miles in length. A new contract has been made for a period of ten years, for the supply of water from the city works, to the districts of Southwark and Moyamensing, in which are pipes laid measuring $15\frac{1}{4}$ miles, and making with those in the city a length of $82\frac{1}{4}$ miles.

The water is distributed by means of mains and service pipes of different dimensions, passing through the streets, and by small pipes entering the premises of every water tenant, under the pressure of a head of water, equal to the height of the reservoir. It is consequently delivered at such part of every tenement as the tenant may prefer, by a regular stream running at all times except when the stop-cock is closed. It is the same mode of distribution which is proposed in this City. Every tenant takes as much water as he pleases, and when he pleases, for his own use, paying a moderate compensation, regulated by general rules, as nearly as is practicable according to the quantity wanted, by each class of tenants. The whole amount of income from the city and districts, paid into the Treasury the last year, after deducting commissions, was \$151,501. The whole amount of expenses of the year was \$24,332, in which were included \$8,242, for extending the works by laying 6,618 feet of new pipe, in streets not before provided for; leaving the amount of current expenses for the year \$16,090. Of these expenses, \$5,970 were for expenses of the Fairmount Works, \$2,249 for wages and repairs connected with the water power, \$3,321 for distribution, and \$4,547 for salaries and incidentals.

The quantity of water supplied during the year gave the following averages per day, viz:—

From Jan. to April,	3,654,517	gallons.
“ April to July,	5,445,291	“
“ July to Oct.,	6,949,911	“
“ Oct. to Jan.,	4,872,102	“
<hr/>		
Daily average for the year,	5,330,455	“

This supply was to 28,082 tenants, of whom 17,521 were in the city, and 10,561 in the five districts. Of the city tenants 14,021 pay the established rents, and 3,500 families are supplied without charge from public hydrant pumps. The average supply of water per day to each tenant was 189 gallons through the year, and 247 gallons per day during the three summer months. This rate of supply gives for 17,521 city tenants, a daily average of 3,325,600 beer gallons, or 4,000,000 wine gallons through the year. A like computation gives for the supply of the three summer months, a daily average of 4,327,687 beer gallons, or 5,200,000 wine gallons. The amount of rents, arising from city tenants standing on the books on the 31st of December last, was \$76,055. The most numerous class of tenants are those who pay \$5 each, this being the ordinary charge for the supply of a dwelling house. The smaller class of tenants however pay \$2.50, and dwellings of the largest class pay \$12.50. Baths to the number of 2,337 are charged \$3 each. Printing offices pay \$8; distilleries \$15; stables various prices, from \$4 to \$50; steam engines \$9, to 54; taverns and hotels, \$13, to 96; bath-houses, \$110, to 138; and sugar-houses, \$150, to 750.

The demand for water thus described, it will be observed, is from the population of the city alone, which is less by 10 or 15,000 than the present population of the City of Boston. It is a city also where there must be a considerable less demand than in Boston, for the supply of shipping, locomotive engines, and certain descriptions of manufactures. The people of Boston, like those of Philadelphia, live in good houses, are of cleanly habits, and know the uses of water, although they have been compelled to use it sparingly. No one accustomed to observe the advantages of an abundant supply, from the manner in which it is used in Philadelphia, can believe for a moment, that the people of Boston, when furnished with it in a similar manner, from an inexhaustible source, will adhere to the use of their wells and cisterns, although in abandoning the latter, they may be obliged to set down the cost of them as a

dead loss. Nor can it be reasonably supposed that they will be satisfied with a less ample supply, than that which has been found necessary in the former city.

8. *Misrepresentation corrected.*

Mr. Shattuck has, we presume, unintentionally, misrepresented the statement of the Commissioners of 1837, in relation to the quantity of water supplied by the Fairmount Water Works, to the inhabitants of the City of Philadelphia. Referring to this Report, he says, "I shall show this statement to be an over-estimate." The only statement in regard to the supply of Philadelphia, in either of the Reports of those Commissioners, is in the following words:

"In Philadelphia, the supply in 1836 was, *for the City alone*, 13,632 tenants, 160 beer gallons, equal to 194 wine gallons each; 2,644,608 gallons. The population of the City of Philadelphia was in 1830, 80,462. In 1836, it was probably 93,000. The supply therefore was $28\frac{1}{2}$ wine gallons to each inhabitant. This exceeds in a very small degree the average quantity furnished in London, and we have adopted it as the basis on which our calculations for the supply of Boston are founded." Rep. 1837, p. 5.

Any one who will take the trouble to consult the Report of the Philadelphia Watering Committee, for the year 1836, will find this statement to be strictly correct, except that the estimate of the population of Philadelphia in that year, was a little too high, as appeared from the census of 1840, not then taken. This should have been taken at 88,000, instead of 93,000, and the result of the computation would have been 30 gallons to each inhabitant instead of $28\frac{1}{2}$ to each. This is proved also by the statement given in the table published by Mr. Shattuck, in which the supply of tenants *in the City*, is given precisely as above stated. The table instead of showing that the statement of the Commissioners was over-estimated, shows that it was not over-estimated. It shows also, it is true, that the supply to the city and districts, taken together, was in a much

less quantity in proportion to the population. But this was a fact of which the Report of the Commissioners took no notice, because it was irrelevant to the purpose. It would have been misleading the public to ask them to rely upon it, because the condition and pecuniary circumstances of the inhabitants of those districts, is not analagous to those of the inhabitants of this City, taken as a whole, and also because those districts are not, and never have been fully supplied with water, from the city works, as the relative number of tenants in the city and districts clearly shows. Yet, although this was apparent from the table, as well as from the Philadelphia reports, and although the statement of the report of the Commissioners, referred to by Mr. Shattuck, was distinctly limited to the supply "for the city alone," he goes on to assert as a fact proved by this authority, that the supply was 18 gallons to each inhabitant, "and *not* 28½ *as stated above.*" His words are, "in 1840 the population of the water districts was 220,423, and the number of water tenants 23,482, which gives one tenant to nearly 10 inhabitants, or 18 gallons to each, and not 28½ *as stated above.*" It will be perceived from the above explanation, that there had been no such statement, in regard to the districts, and that the contradiction is not true in regard to the city without the districts.

Some comment seems to be called for upon another passage of Mr. Shattuck's pamphlet, viz.

"The Commissioners say (Doc. 33, 1838) that to each inhabitant in Liverpool 8½ gallons are required; in Manchester, 11½ gallons; in Greenock, 15 gallons; in Glasgow, 17 gallons; in Edinburgh, (the most magnificent works in Great Britain) 20 gallons; in London, 27½ gallons," &c.

It might be inferred from this statement, that the Commissioners had cited these examples as authorities on which to rely, for determining the quantity which should be provided for, in the works for the supply of the City of Boston. They did in fact regard them as entitled to consideration, especially as the cities of London and Philadelphia afforded the only examples then

known, in a city subject during a considerable portion of the year to the influence of a cold climate, of so large a supply as that which formed the basis of the estimates which they had made, in showing that there was a probability that the actual demand for the City of Boston, might fall short of that estimate. This consideration they regarded as entitled to weight, in determining the choice between two modes of supply, both which were capable of affording the full amount of the estimate, but one of which would admit of a material saving, in case the smaller quantity should prove sufficient. But at that time they had not had the benefit of the long continued experience of Philadelphia, nor were the multiplied ways, in which an abundant supply of water contributes to the comfort of the inhabitants of that city so well known to them, as they are at present. In citing these examples for this purpose, they did it with the utmost caution, and careful qualification, as will appear from the following remarks in their report, by which the reference to them is introduced.

"In taking this great quantity, therefore (28½ gallons to each individual) as the standard for the supply of this City, it should in our opinion be borne in mind, that *it may be found greatly to exceed*, not only the quantity which will be required, but the quantity which will be used. Still *we would not for one moment recommend* any source of supply, which should not be *capable of yielding this full quantity*, not only to the present inhabitants, but to a population increased greatly beyond our present limits. If however of two places proposed for supply, *either being capable of yielding this quantity, and at the same cost*, one of them from the character of the works required can be executed upon a more limited scale, than that required for the full quantity specified as the standard in our estimates, and afterwards extended *without any greater outlay* than would be necessary to carry out the full plan at once, while the other plan must, from the kind of works on which it depends, be constructed at first to its full extent; then in our opinion the former plan is to be preferred to the latter, in a greater or less probability of the more limited supply being sufficient for some time at least for all useful purposes." Rep. of 1838, p. 12.

This passage of the report shows clearly with what view the Commissioners referred to these examples. After adopting those of the Cities of London and Philadelphia, they cited these, regarding most of which they had very little specific information, as showing that their standard examples *might prove* too high. Mr. Shattuck, on the other hand, rejects altogether the examples adopted by the Commissioners as their standard, and adopts as authorities in support of his estimate, the lower examples which they had quoted with this careful qualification. More recent information shows, as will be seen in what will be hereafter stated, in regard to the supply for Liverpool, and as might also be proved in regard to several of the other towns named, that those places are far from being adequately supplied. These quantities are the measure of the supply which is obtained, at high prices, and not the measure of a full supply, adequate to the public wants.

9. *Rates of supply in other cities.*

If it were necessary to determine with the utmost precision, the question of the average quantity of water, which would be sufficient for the adequate supply of water for the use of such a population as ours, many curious facts might be presented, obtained from various sources, both in this country and in Great Britain. But after all, there would be a good deal of uncertainty as to the actual quantity which would be demanded, under such regulations as the City Government would be expected to adopt, and the only safe method seems to be, to adopt such a system of supply as will be far more likely to afford an excess than a deficiency, especially as it will be found that the most liberal supply which any one has proposed, will involve a cost in but a small proportion greater than the most sparing. This consideration fully justifies the assumption of a standard by which to measure the proposed supply, which is far above a mere provision for the use of all the families of the city, for domestic purposes. The statement of the uses to which the water provided to the inhabitants of Phil-

adelphia is applied, shows that a very large part of it, perhaps nearly one half, is required for other than strictly domestic uses, viz: for various manufactures, streets, extinguishing fires, &c. This accounts, in part, for the greater quantity demanded, than is used in various English towns, where, with the exception of the City of London, the appropriation to these other uses is far more limited. Part must be attributed to the much larger domicils, and the far more liberal style of living in our most flourishing towns, especially among the manufacturing and laboring population, than is to be found in the corresponding classes of population in England.

In the City of London, water is supplied by several rival companies. In some instances, the pipes of three or four companies, in addition to gas pipes, pass through the same streets, causing great confusion and frequent interruption of the streets, from the frequent disturbance of the pavement, which becomes inevitable. Several instances have occurred in which, in consequence of defects in the pipes both for water and for gas, in juxtaposition, the water has escaped, and the vacuum has been supplied with gas, and the water tenants have been surprised, by their taps taking fire and producing an explosion. The consequence of the rivalry between the companies is, that they produce an average income to their proprietors, of not more than two or three per cent. per annum. Another consequence of the low price is, that the quantity used is much larger in proportion to the population supplied, than in any other town in England. It appears from the report of testimony given before a Parliamentary Commission, for inquiring into the state of large towns and populous districts, in the years 1843 and '44, (in which is to be found a large amount of curious and valuable information, relating to the various modes of promoting and securing the public health, and particularly in relation to drainage, ventilation of buildings, and supply of water,) it was stated that the quantity of water supplied daily by the various companies of London, in the year

1843, amounted to an average of 45,500,000. This included the supply for both manufacturing and domestic purposes for a population of 1,874,000; and it was equal to an average of 24½ imperial, or 29 wine gallons to each inhabitant of the City. It is stated further, that about a third of the population do not take water from any company, but rely, as do most of the citizens of Boston on such supplies as they can obtain from wells, pumps, and rain. This leaves to the 1,200,000 inhabitants, and 200,000 houses computed to be supplied, an average of 36 imperial gallons to each person, and 227 gallons to each house. There can be no doubt that this is a far greater quantity than is required for domestic uses, and that a very large portion of it is required for a thousand manufacturing purposes. An abundant supply of water for these uses is of immense importance, in promoting the industry of a manufacturing city, and the uses are such as will readily command an adequate compensation.

Mr. Robert Thom, a Civil Engineer, who had for many years given attention to the mechanical means of supplying towns with water, stated to the Commission above referred to, that when speaking of a supply, he always meant two cubic feet or about 13 gallons per diem, for every individual of the population. This is about 15 wine gallons. In reply to the question if he were aware that this was "very much below the consumption in London," he said, "I am aware that it is so stated; but *as a family supply merely*, I rather think it will be found to exceed that of London." "Four years ago," he adds, "I had the means of ascertaining the quantity supplied to Glasgow, and found that it did not amount to 13 gallons for each, and of which nearly one fourth was suffered to run to waste, from the imperfect state of their works. In Perth the quantity supplied to each individual was only 8 gallons. In Greenock and Paisley, where the pipes are kept constantly full, and there is nothing to prevent the people from using what they please, the quantity taken is less than 12 gallons for each. These facts lead me to question

reports which state *the family supply* beyond 13 gallons per diem. In London doubtless the quantity used for watering the streets, for public works, and the like, must be very great."

In some of the large towns of England the supply of water is much less than in the above ratio, and there is consequently much suffering from a deficiency of water. The following statement is from the testimony of Samuel Holmes, Esq., given in the investigation by the Commission above named.

"Liverpool is supplied with water by two public companies, each having an act of Parliament which confers upon them a monopoly of supply. One is termed the Bootle Water Company, the other the Liverpool and Harrington Water Company. The former Company receive their supply from the Springs at Bootle, distant from the Exchange three miles, and the latter have wells in various parts of the town. The original shares of £100 in the Bootle Company are now worth in the market £380, and those of the Liverpool and Harrington £600. The charge for supplying water for domestic use, is one shilling in the pound on the rental, and it is usually supplied every other day. It therefore follows, that had the corporation or the parochial authorities originally supplied the water from the public funds, and no legislative enactment had given to these companies exclusive privileges, we should have been supplied with water at one sixth of the present price, or if we had paid the same price, a large disposable revenue would have accrued to the public local exchequer, which would have diminished our taxation."

In consequence of the insufficiency of the supply of water afforded by these companies, and the delay which usually occurred in obtaining it, many calamitous fires had occurred in Liverpool, which, since the commencement of the present century, have destroyed property to an amount exceeding £2,000,000. The attention of the community was at length aroused to the necessity of some remedy, and in consequence an act was obtained authorizing the levying of a tax upon the inhabitants, and the laying of pipes for the supply of water, but with a restriction, from the opposition of the water companies, which limits the use of the water so provided to

the extinguishing of fires, watering the streets, and other public purposes, and prohibits the use of it for domestic purposes. In some further remarks upon this subject, M. Holmes says, that he considers the monopoly enjoyed by the two great water companies as prejudicial to the health of the community. They supply water at such a cost, as to afford a profit to the proprietors of one of the companies of 30 per cent. on the investment, and in the other of 19 per cent. As the shares are transferable in the market, this is right enough, but it is a great misfortune to the town, and one that is severely felt. Water is purchased not only for private dwellings, but for all the public buildings, and charitable institutions, and its scarcity induces many of the poorer classes to obtain it surreptitiously, and thus obtaining it is not considered a crime.

“Water,” Mr. Holmes remarks, “is as essential to the health and comfort of mankind as the air we breathe; and when men congregate in masses, counted only by tens of thousands, it is essential to the public health that it should be most abundant,—not doled out to yield to others 30 per cent. interest, but supplied from the public rates, and at the net cost. That cost ought only to be the price of raising and distribution; and in this town, pure water may be found in every direction, and in superabundance, at an average depth of 120 feet. If we had fountains, at once useful and ornamental, in every direction, as in most of the cities of the continent, and baths in every locality, so that water was free to all, the benefits would soon be perceived. I am convinced that if the interest of the two water companies were purchased by rates levied for the purpose, even at their high premium, the town would soon be the gainer; for it is impossible that the public will be much longer satisfied with the price and comparative scarcity of water, and the power recently obtained to distribute water for extinguishing fires will be sought to be increased.”

There are other towns which are supplied at a rate exceeding the estimate of Mr. Thom, above stated. The situation of the town of Preston is described in

the testimony of the Rev. J. Gray, before the above mentioned Commission, as having been very similar before the establishment of a water company, to that of Boston at the present time, except that the town is much smaller. Water was supplied from various sources, wells, pumps, water casks, rain water cisterns, &c., besides private works erected in 1729, which afforded a limited supply. Under an act of Parliament, the Preston Water Works Company had been established, which brings an abundant supply of excellent water from a distance of about seven miles. Already more than half the houses in town, 5,026 out of 9,994, are supplied with water by the company, and there is an increase in the number who take it, of about four hundred annually. The average number of inhabitants is a fraction over five to each house. Tanks or cisterns are never used, but a tap, connected with the mains, is placed in each house, providing an unlimited quantity. The poor are generally supplied by the company at the expense of the landlord. The charge varies with the rent of the house supplied; 10 shillings is the lowest rate for a single house, and £8 the highest, and when a number of houses belonging to the same landlord are supplied, the charge is sometimes as low as 7 shillings. The average supply is equal to an average of about 80 gallons to each house daily, factories and public establishments included. This is equal to 16 imperial or 21 wine gallons to each individual supplied, of a chiefly laboring population, and evidently with a small allowance for public and manufacturing purposes.

T. Hawkesley, Esq., Civil Engineer, who constructed the Trent Water Works, for the supply of the town of Nottingham, testified that those works supply 8,000 houses, containing a population of about 35,000 persons. They are supplied on the high pressure principle, having the water constantly on, and without tanks. He states that "the actual amount of supply at Nottingham, is not more than from 80 to 90 gallons per house per diem; this is taken by about 8,000 tenements and works of every description, among which are breweries,

dye works, steam engines, and inns, and other places of large consumption." It is stated, however, that a very large proportion of the houses are small tenements, consisting of a single room, so that 5,000 of the 8,000 pay for the water which they receive an average sum of 4s 7½d each, per annum, which amount is charged to the landlords, who include it in their weekly charges of rent to the tenants. The charge by the water company is apportioned according to the rental of the houses, the required supply of water being computed in that proportion. The consumption of water allowed to each house is computed by the following rule: To "houses of £6 rent, 40 gallons per diem; £10 rent, 56 do.; £20 rent, 88 do.; £50 rent, 163 do.; £100 rent, 260 do.; £200 rent, 410 do.; £500 rent, 756 do." This shows that the average supply of "80 to 90 gallons per house per diem," is computed upon a very small class of houses. The same fact is inferable from the number of persons supplied, which is but 4½ to a tenement, the quantity of water supplied being in the proportion of about 20 imperial, or 25 wine gallons to each person.

These and other similar facts, which may be gathered from the mass of testimony above referred to, go to convince us, that the quantity of water required for the full supply of the inhabitants of Philadelphia, for both family and manufacturing uses, is not greater than it might be expected would be demanded, by a population living in a condition of so much ease and comfort, in so large and commodious houses, and carrying on so many occupations requiring the consumption of water, as those of that city. This inference is further justified by the well authenticated facts in regard to the supply of London, referred to above.

10. *Inferences from the facts stated.*

It remains only, before disposing of this topic, to compare these facts, showing the quantity of water actually used in these cities, with the estimates of Mr. Wilkins and Mr. Shattuck. Mr. Shattuck's estimate of the greatest quantity which will ever be required, is

1,050,000 gallons a day, besides the supply from Jamaica Pond, which is estimated at 200,000, making 1,250,000 gallons. This is equal to 10 gallons to each inhabitant, taking the estimated population at the time when the works will be completed. It is a fraction less than the supply in the town of Liverpool (8½ imperial, or 10 2-5 wine gallons) where as is shown above, the regular price paid for water for domestic use, is a twentieth part of the rent, and where it costs the inhabitants six times what it would have cost, if it had been introduced at the expense of the City, instead of being subject to a monopoly, granted to private companies, as Mr. Shattuck and others, recommend should be done here.

Mr. Wilkins expresses the opinion that it is "a very liberal estimate" to allow 10 gallons a day to each inhabitant, on the completion of the work, but with an increase in population as the citizens shall get accustomed to its use, rising to 16 gallons at the end of 10 years. His lowest estimate is a trifle less than Mr. Shattuck's maximum, and his maximum it will be observed is but a fraction over the quantity required, according to the testimony of Mr. Thom above cited, as the average supply to English and Scotch towns, consisting in great proportion, of laboring population, *for family use* alone. We find nothing in the facts above cited, or in the example of any city, or town, where the actual amount of consumption has been ascertained, to justify the belief that so low an estimate is sufficient, for the domestic, manufacturing, and public uses of any large town, much less for a population so accustomed to a comfortable style of living, and so able to supply themselves with what is necessary for their convenience, as those of the City of Boston.

Is it not far more reasonable to suppose, that the demand for water in the City of Boston will be in a full proportion according to its population to that required in London and Philadelphia? The proportion of the inhabitants who live in small and crowded tenements, or in a manner to demand a very limited use of water,

is perhaps as small as in any city, in this or any other country; and the consumption of it in the supply of steam engines and in other manufacturing and economical uses will probably be as great as in any city. The consumption in the City of Philadelphia, has been increasing from year to year faster than the population, and in 1844, estimating the population at 95,000, it was equal at least to 33 beer gallons, or 39 wine gallons, per day, to each inhabitant, for the average of the whole year. In London, in 1843, the supply from the water companies was equal to 29 wine gallons to each inhabitant, leaving 70,000 houses unsupplied. The average supply of the two cities is therefore equal to 34 gallons to each inhabitant.

In relying upon the above cited authorities to show that this is a fair measure, of the supply of water which ought to be provided for the City of Boston, it is not necessary that we should prove beyond doubt that this quantity will be positively demanded, at least during the whole year. It is enough for our purpose, if we show that the demand may by possibility, be equal to to this proportion. Let this only be admitted, and all the reasoning of Mr. Wilkins and Mr. Shattuck is extinguished at once. Let it be but admitted that the City of Boston, with a present population greater by 10 or 15,000 than that of Philadelphia, will probably require an equal quantity of water, and that our citizens are as able to pay for it, and our whole case is conceded. Concede but this and the whole argument of our opponents is refuted. It is for the reader to judge whether this must not be of necessity conceded. Is it possible to contend against the evidence of these facts? Can it be pretended that what is proved by unquestionable testimony to have happened to the population of the City of Philadelphia for a series of years, may not possibly, and even probably, happen to the people of Boston, when placed in like circumstances, by having an ample supply of pure water placed within their reach, at a reasonable price?

We feel warranted in assuming, upon the strength of

this evidence, that it is the imperative duty of those who are entrusted with the power of determining the source from which the supply for this City, to adopt a standard equal to this, in measuring the supply for which they are to provide. To adopt a lower standard, will be to put at hazard the future welfare of the City, for the mere show of economy, without any reasonable prospect of a saving in fact. True economy requires that this expensive work should be placed upon the basis of a certain adequate supply for many years to come. This standard, on Mr. Wilkins's estimate of the increase of population, will give 4,080,000 gallons, as the average quantity required from the date of the completion of the works, and 5,440,000 at the expiration of ten years. With so strong evidence of the probable demand for this amount, within the short space of ten years, it can hardly be pretended that 7,000,000 gallons is too high an estimate of the prospective demand, at no very remote period, especially if, it should be shown that it may be obtained, without any material increase of cost, over what will be necessary in any mode of supply, which can be relied on for the immediate demand.

II. THE PREFERABLE SOURCE FROM WHICH TO OBTAIN A SUPPLY.

The next question for consideration is the source from which such a supply of water can be most advantageously derived. This question resolves itself into two branches. 1st. From what source can a sufficient supply be obtained at the least cost? and 2d, the more important question of the comparative purity of the water afforded by each.

1. *Comparative cost of Water from Long Pond and other Sources.*

The first of these inquiries may be considered as answered, by the facts and reasonings by which we come to the foregoing conclusion, in regard to the quantity

which ought to be provided; and it is on that account, that it has been deemed necessary to treat that question so much at length. If there is any reliance to be placed on the foregoing conclusions, it would be an act of extreme folly to undertake works, upon a system which would not be adequate to a supply of six or seven millions of gallons per day. It is well ascertained that there is no source from which that quantity can be obtained nearer than Long Pond, and which can be made available, without the expense of pumping the water to the necessary elevation, by steam power. We conceive it to be also equally well ascertained, that the necessary quantity can be introduced from Long Pond at a less cost, than from any other source.

2. *Cost of Pumping from Charles River.*

Mr. Wilkins recommends in preference the water of Charles River. The principal object of his pamphlet is to prove that this is the preferable source, on the two grounds, that the water is better, and that it can be introduced into the City at a less cost. His argument to prove that the supply can be introduced from Charles River at a less cost than from Long Pond, depends solely upon an arithmetical calculation, based upon a comparison of the estimates for Charles River, as made by the Commissioners of 1837, and for Long Pond by those of 1844. The means by which he brings his calculations to a different result from that of the Commissioners, are, 1st, by assuming that a *third part* of the quantity of water, which they deem it expedient to provide for, is all that will be required, and in fact that two thirds of the quantity provided would be a wasteful excess; and 2d, by some modifications of the estimates adopted as the basis of calculation. That is, he makes a slight addition to the estimate for Long Pond, by increasing the rate of allowance for contingencies, without specifying any additional charge, and makes some material deductions from that for pumping from Charles River, on the ground of the reduced cost of materials since the date of the estimate, as follows:

Commissioners' estimate for 7,000,000 gallons from Long Pond,	\$809,776	
He adds 12 per cent. for contingencies instead of 10 per cent.	97,173	\$906,949
Estimate of 1837, for works and capital equivalent to annual cost of pumping 2,500,000 gallons from Charles River,	\$488,966	
From which he deducts, for re- duced prices since 1837, in		
pipe, lead, &c.	\$41,405	
Fuel,	20,000	
Engines,	7,000	
	<u>68,405</u>	
	420,561	
Add for contingencies, 12 per cent,	50,467	471,028
Saving in adopting Charles River,		\$435,921

Upon this estimate two remarks are to be made. 1st, that it is based upon the fallacy that 2,500,000 is all that is required, and that the seven million gallons to be introduced at a cost of \$906,949 will be of no more value, than the 2,500,000 to be introduced from Charles River at a cost of \$471,028. If we have succeeded in the foregoing remarks in exploding this fallacy, the argument based upon it is of course exploded.

The reduction here made for difference in capital allowed, on account of the reduced cost of fuel, we believe is excessive by at least one half, and the diminution for the estimated cost of engines of the description proposed, is not warranted by any facts within our knowledge. We therefore strike off from these deductions \$17,000, and we must add for increased value of the water rights at Watertown at least \$25,000—the privilege being now occupied by two factories in successful operation, with buildings of considerable value, which in 1837 was vacant.

Taking therefore the estimate for Long Pond as Mr. Wilkins gives it :

7,000,000 gallons, with 12 per cent. for contingencies, is		\$906,949
2,500,000 from Charles River, estimated in 1837 at	\$488,966	
Deduct on pipe, lead, &c.,	41,405	
Deduct on fuel,	10,000	
	<hr/> 51,405	
	437,561	
Add increase on water rights,	25,000	
Contingencies, 12 per cent.	55,507	
Total	<hr/> 518,070	
Difference,		<hr/> \$388,879

Here is a difference, it can hardly be called a saving, of \$388,879 in the cost of the two modes. If it is to be regarded as a saving, it is a saving purchased at a sacrifice of 4,500,000 gallons in the amount of supply. It will be accompanied also with the inconvenience and hazard, of being required to maintain permanently an extensive system of pumping machinery, and steam engines, subject to the responsibility of perpetual supervision and management, instead of a work of simple and substantial masonry, apparently as durable as the earth itself, or at least as durable as those works of antiquity which have escaped destruction from acts of civil violence.

Now it is to be observed that the cost of bringing water to the reservoir on Corey's Hill, in whatever mode it may be brought there, is less than half the cost of supplying the city, including the introduction from that reservoir, together with the distribution at the residences of the inhabitants. This latter branch of service is estimated at \$1,200,000, and the former in the most expensive of the modes, at \$900,000. Now the question to be considered is, whether it is an economy worthy of the attention of the city, to make a saving of 40 per cent. in the cost of merely bringing the water to Corey's Hill, or 20 per cent. on the whole cost of the works, at the sacrifice of two thirds of the quantity which will be ultimately wanted, and of nearly

half the quantity wanted at the present moment. The answer which will be given to this question cannot be doubted.

It is true this deficiency of four and a half millions may be provided for, by a further estimate for pipes and pumps and fuel, for obtaining an additional quantity from Charles River. The additional cost to be thus incurred, it was no part of Mr. Wilkins's course of reasoning to state, because he goes entirely on the assumption that the additional supply would be superfluous. He does indeed intimate that the works provided in the estimate, if the pumping be continued through the 24 hours of every day, instead of 20, might be made to deliver three millions of gallons, in place of two and a half. It is sufficient to say in reply to this, that so far as the estimate of 1837 is relied on for an authority, it should be taken as conclusive only for the quantity for which the scale of work was specially adapted. If it had been thought safe to compute the dimensions of pipes, and size and form of engines and pumps, of the exact dimensions theoretically adapted to the attainment of the object by perpetual working, without any accidental suspension, or power in reserve, for any contingent failure of the computed effect, it is probable the plan of works would have been arranged in conformity with this supposition, and the estimate would have been of course on a scale reduced in that proportion. It is therefore unreasonable to assume the estimate of 1837 as sufficient, (without other authority to justify it,) for a greater permanent practical effect, than the works proposed were designed to produce. The two pumps might doubtless be made to perform, temporarily, a much larger service than that of supplying two and a half million gallons per day. But to provide the increased supply which we assume to be necessary, works of greater magnitude and cost would be indispensable, and also greater consumption of fuel, and a greater expenditure for labor and attendance. A part of these expenditures, particularly the cost of fuel, which is the greatest sum, would be in proportion to the

increased quantity demanded; all the other items of cost would be increased, but most of them in a less proportion. We should not deem it necessary to go into an estimate of this increased cost, if we were possessed of all the materials for it. There can be no doubt, we think, that any safe estimate for accomplishing the object, would be higher than that of producing the same effect by the introduction of the water of Long Pond.

Mr. Wilkins intimates that important improvements must have been made within the last seven years, in constructing engines, and that a reduced cost may be relied on upon this ground. An attempt was also made in the hearing before the Committee of the Legislature, on the City Petition, to prove that some improved principle of pumping had been introduced in England, from which a saving of cost might be anticipated. It is well known that the estimate on which Mr. Wilkins founds his computation, and on which these improvements are expected to be made, is the estimate of Mr. Treadwell, than whom no one is more competent to introduce the highest degree of improvement in this branch of machinery, and it was founded by him on the supposition of introducing the most approved form of engine used in the Cornish mines, the construction and performance of which were well understood by him. The performance of these engines has probably exceeded that of others, in any part of the world, in the effect produced by a given quantity of fuel. At the time when his report was made, engines of this description had not been adopted by any of the water companies in England; but since that date one or two have been introduced.

Mr. Treadwell's estimate of the cost of pumping by steam power has been regarded by civil engineers as extremely low, and it is undoubtedly far below the cost at which an equal effect has been produced, by any engines in use in this country, and lower than the usual cost of raising water, for the supply of towns, in England, allowance being made for the difference in the cost of fuel. Still, such is our confidence in the judg-

ment and skill of Mr. Treadwell, in matters of this sort, that we should have no hesitation in trusting to the accuracy of the estimate, and in the result of works constructed on the principle recommended by him, corresponding with his estimate, if executed under his supervision. But should we not venture to make any deduction from that estimate, except to the extent of any reduction in the cost of materials of construction, and of fuel. We see no warrant whatever for the supposition, that any improvement is to be expected upon the principle of construction assumed in it, except the vague one, that as surprising improvements are constantly making in many of the mechanic arts, that branch which has already outstripped all others, is likely to make farther advances. This is quite too unsafe a ground to rely upon.

We might quote a variety of facts in confirmation of the above reasoning, from the minutes of testimony before the Parliamentary Commission above referred to, particularly that of Mr. Wickstead, the Civil Engineer, in the service of several of the London Water Companies, by whom the principle of the Cornish engines has been introduced, and that of several other engineers. But this would require a length of detail which would tire the reader, and it would perhaps be a superfluous labor.

3. Estimate of Pumping for the Philadelphia Districts.

In comparison with this estimate, we are able to present that which has been made by the Water Commissioners of the new Water Works, of the Districts of Northern Liberties and Spring Garden, in Philadelphia. These works have been recently completed at a cost of \$203,000 for engines and pumps, reservoirs and mains, to conduct the water from the pump to the reservoir, and thence to the distributing pipe; these latter having been previously provided, for the distribution of water obtained from the City reservoir. The works went into operation on the 1st of January last, and the cost of pumping has not been tested by the experiment. We

learn, however, that the power of the pumps exceeds, in the quantity raised, that of the estimate.

Estimated annual cost of raising two and a half million gallons of water per day, from the Schuylkill to the reservoir, 127 feet in height :

2,800 tons coal at \$3.25 per ton,	\$9,100
Repairs, oil and contingencies,	2,700
Engineer, assistant, and two firemen,	1,700
Salaries of superintendent and clerk, office expenses, printing, &c.	2,900

Total per annum,	16,400
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Equal to a capital at 5 per cent. of	\$328,000
Cost of works,	203,000

Total cost of 2,500,000 gallons per day,	\$531,000
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This is near \$100,000 over the estimate of Mr. Wilkins, although the distance which the water is conveyed is but one mile, instead of three and a quarter miles.

4. *Estimated Produce of Spot Pond.*

Mr. Shattuck recommends not only Charles River but Spot Pond, in preference to Long Pond, his preference for both, arising evidently from his opposition to them all. His estimates in regard to Spot Pond are so full of errors, that to guard against the appearance of misrepresenting him, we quote his own language, which is as follows :

"The Commissioners in their report, of 1837, page 13, say that Spot Pond contains 280 acres, and may be relied upon to furnish 2,100,000 [gallons] daily. It seems to me, however, that it is a fact, capable of demonstration, that it may be made to do much more than that. The pond may be raised seven feet above its ordinary level, which will give 60 additional acres, and increase to 340 acres; and water may be taken from it ten feet below its ordinary level, at which point the pond is estimated to contain 200 acres." [Here

follows a computation to show that the pond with these dimensions, filled to a level of 17 feet from the point to which may be drawn, will afford, exclusive of any accessions from springs or rain, 1,166,319,000 gallons of water for the service of the City.] “This quantity *will be there every year on the first of May, and if drawn off, would be filled up again in November.* How many gallons per day then could be drawn off from it in six months, as 183 days from May, allowing the occasional rains and springs which supply the pond, to equal only the evaporation? This is ascertained by dividing the above number by 183, which gives 6,373,326 gallons. These calculations are based upon reliable facts.”

Here is what Mr. Shattuck calls a *demonstration*, that the pond will produce yearly *more than four times* the quantity which it was accurately ascertained by measurement to produce in the year 1837-8,—that being the only year, in which any measurement of the quantity discharged from it, is known to have been made. By reference to the two reports of 1837 and 1838, both which are quoted by Mr. Shattuck, it will be seen that the whole discharge of water from Spot Pond, *including all that came into it by rains, streams, or springs*, was actually measured, by careful observations made twice a day in the most exact manner, under the immediate direction and frequent observation of the Commissioners, from the 31st of March, 1837, to the 31st of March, 1838. The whole quantity, making an allowance by computation for the difference of level, at the beginning and at the end of the year, amounted to 1,444,121 gallons a day only—less than a quarter part of this demonstration. This is the result of a measurement made with a care and exactness, in a manner particularly described in one of the reports, which we will venture to say, entitles it to a greater degree of confidence than any measurement, which has been made, for a public purpose, of a natural flow of water, in any part of the Commonwealth. So far from filling to a height of 17 feet in the month of November, as Mr. Shattuck supposes would be a matter of course, all the water which flowed into the pond from rains, streams and springs during the whole twelve months, were insufficient to

raise the level of the pond more than $7\frac{1}{2}$ feet, had not a drop been discharged from it in the mean time.

It is true that the year when the abovementioned measurement was made, was one of unusual drought, but the very last summer was nearly as dry. It is true, also, that the Commissioners of 1837, in their first report in November, made when their observations had been continued only seven months, believing that the pond would be filled during the following winter, computed the average daily supply, at 2,100,000 gallons, as quoted by Mr. Shattuck. In their subsequent report they gave the result of the actual measurement for the year, and corrected the error of their estimate, which correction Mr. Shattuck has neglected to quote. In lieu of doing so, he has substituted the "demonstration," above quoted, to show that the pond by raising the dam seven feet, might be made to contain six millions of gallons per day, instead of 1,444,000. What is the use of creating a pond which is capable of holding six millions of gallons, if there are but 1,400,000 to put into it?

5. Comparative height of the discharge from Spot and Long Ponds.

Mr. Shattuck proceeds to recommend Spot Pond in preference to Long Pond, on the ground that the former is 24 feet higher than the latter. The actual difference of level, as stated in the reports repeatedly quoted by him, is but $19\frac{1}{4}$ feet; and if he had not overlooked the law of hydraulics, which renders a certain fall necessary to admit of the discharge of a given quantity of water, through a pipe of certain given dimensions, he would have found that a pipe of the size which he proposes, would be barely sufficient to deliver—not six millions—but $2\frac{1}{2}$ millions of gallons a day upon Beacon Hill, at a level *seven feet lower than that* at which it is proposed to deliver it from Long Pond.* Spot Pond, therefore, possesses no advantage in this particular, as the advantage of additional elevation is more than lost,

* See Report of 1837 p. 35, and Rep. of 1844, p. 20.

in the necessity of introducing the water by pipes, instead of introducing it by an aqueduct of larger dimensions.

6. *The Spot and Mystic Pond project.*

It is known to those who are conversant with the history of this subject, that two of the Commissioners of 1837, Messrs. Treadwell and Hale, recommended the introduction of the water of Spot and Mystic Ponds, in preference to that of Charles River, on the ground of its greater purity, and in preference to that of Long Pond, on the two grounds that a supply for the population at that time, (estimated at 80,000) could be thus obtained at a less cost, and that an injurious effect was apprehended from the American hydraulic cement upon the water, had the form of aqueduct, requiring the use of that material been adopted. This last objection, to the mode of introducing the Long Pond water, is now entirely removed, by full experience, and the most satisfactory observation of the nature and entire adaptation of the cement to the object, it being entirely indissoluble, and harmless in its effect, on the purity and softness of the water. The argument which was then made, for the greater cheapness of the Spot and Mystic Pond project, by the actual increase of the population since that time to 110,000, with the prospect of a continued increase in the same ratio, is also entirely refuted by this great increase of the quantity demanded. That project was to make use of the water of Spot Pond, (as much as there might be of it,) by introducing it to a reservoir on Walnut Tree Hill, near Mystic Pond in West Cambridge, and to supply the deficiency in quantity, by pumping from that pond. The quantity was found, as has been stated, in 1837, to be sufficient for a daily supply of 1,444,000 gallons, and as that was a dry season it was believed that the pond might be relied on in ordinary seasons for an average supply of 1,700,000, leaving an average of 800,000 gallons to be pumped from Mystic Pond, to supply the demand then estimated, of 2,500,000 gallons. The increase of

more than 33 per cent. in the population, during the period which has already elapsed, and the assurance of a large further increase before the works can go into operation, would make it necessary to add at least 1,200,000 gallons to the quantity assumed as the basis of calculation. We must then add to the estimate, the cost of pumping 2,000,000 gallons annually, instead of 800,000, with a prospective increase, greater in proportion, to the greater present population. The advantage in point of cost, as estimated by the two Commissioners who decided in favor of the Spot and Mystic Pond plan, is stated in the following words in these two reports.

"In comparing the two remaining sources with each other, [that is after having rejected Charles River, for the reasons stated, although cheaper than either, by \$80,000] it will be seen that the supply from Long Pond will cost \$268,288 more than that from Spot and Mystic Ponds, the quantity of water brought into the city by the works provided in either plan, for the first ten years being nearly the same. The works as proposed from Long Pond to Corey's Hill however, will have an important advantage over the works of Spot and Mystic Ponds, in providing for the discharge of a large surplus of water, at the reservoir on Corey's Hill, which may be rendered available at a future day, to meet the wants of the city, by laying a new main from that reservoir to Beacon Hill."—Report of Messrs. Treadwell and Hale, Nov. 1837, p. 31.

"In revising the comparison as given in our former report, of these two sources of supply, and the plans of works connected with them, for the purpose of determining which in our opinion ought to be adopted by the City Government, it will be seen that the present estimates of the plan connected with the supply from Long Pond, exceed the sum of \$220,678 the estimated cost of supply from Spot and Mystic Ponds, the supply brought into the city in either plan being equal. If the supply be taken from Long Pond however, it will have the important advantage of furnishing a large surplus at the reservoir on Corey's Hill, which may be brought to the city hereafter, whenever it shall be required by an increased population."—Report of Messrs. Treadwell and Hale, Dec. 1838, p. 9.

Mr. Baldwin, one of the Commissioners of 1837-8, dissented from the opinion of his colleagues, for the following, among other reasons, stated in his letter to the Mayor.

"To the plan of pumping up water by steam power, in whole or in part, for the supply of the City, I object, as it entails forever on the City, the care, trouble and expense of maintaining this power, and of supporting perpetually an establishment for carrying on its operations. The supervision of the work; the agents, engineers, overseers and assistants, which such an establishment will require; the maintenance of work-shops, and the stock and tools which must be kept on hand and in order, together with the necessary provision for a certain supply of fuel at the engine station, let it cost a great or small sum, will impose on the City Government such constant watchfulness and care, as to make it a tedious and perplexing duty, and ought therefore to be avoided."—Report of 1837, p. 48.

It will be seen, that in the face of these objections, a majority of the Commissioners persevered in their recommendation of the Spot and Mystic Pond plan, on the ground that the limited quantity proposed could be obtained, at a saving in the comparative cost of \$220,678, subject however to the reservation that the Long Pond plan would furnish "a large surplus at the reservoir on Corey's Hill, which may be brought to the City hereafter, whenever it shall be required by an increased population." That increased population now exists; the increased supply is now required; and it would seem to be a waste of figures, to go into a computation, to prove that the increased quantity required, will cost more, if obtained by pumping, than the increased cost of the Long Pond plan. But we find the calculation made to our hands, in the report of 1838, above quoted. The supposition was then made, that, at the expiration of ten years, an additional quantity of 1,119,000 gallons per day should be required, and the enquiry was made, whether the above saving of \$220,000, with the interest thereon for ten years, together with the additional cost of pipe from Corey's

Hill to Boston, which would be required on the plan there proposed, would be sufficient to meet the additional cost of the same supply from Mystic Pond. The result is stated in the following words.

"To extend the works connected with Spot and Mystic Ponds, to meet the same demand, [that is, an addition of 1,119,000 gallons per day] will require a new main from Walnut Tree Hill, costing \$319,561, probably an additional steam engine and pump, at Mystic Pond, which, with engine house, will cost \$45,000, and a yearly expense of coals, wear and tear and attendance, of \$5,285, equal to a capital at 5 per cent. of \$105,700; making the whole outlay with contingencies at 10 per cent. added, \$517,287."

This estimate would of course be subject at this time to reduction, for reduced cost of materials, but the statement is enough to show, so far as this authority is relied on, that with all the reductions in cost which can be made, the expense of obtaining the quantity, which we have endeavored to show should be provided, for the immediate demand, from this source, will be manifestly greater than that of the whole supply proposed from Long Pond, to meet both the immediate and prospective demand. Should the present prices of iron be sustained, very little reduction from the above estimate of cost, can be anticipated.

III. COMPARATIVE PURITY OF LONG POND AND CHARLES RIVER WATER.

We come next to the question of the comparative purity of the water of Charles River and that of Long Pond. This is doubtless a question of the utmost importance, but as it is obviously one to be settled by authority, founded on actual comparison by competent judges, we have felt some hesitation in going into a discussion of it here. There are obvious reasons why a question of this nature should not be discussed in all its details before the public.

1. *Animalcules.*

Mr. Wilkins has hastily condemned the water of Long Pond, on the ground that, of two specimens examined

in 1837, by Dr. Jackson, one contained "a few flocculi and oval shaped animalculi," while the other was "free from color, flocculi or animalculi;" and that a single specimen of Charles River Water, was found by him to be "clear, transparent and colorless—no animalculi." He has adopted from Dr. Jackson a description of these animalculi, with some amplification, in a manner to produce, in the minds of many readers, a disgust for all "pond water," as if it were more liable to this, or any other kind of impurity, than river water. He was doubtless not aware that animalculi are as abundant in the water of Charles River, as in that of Long Pond, although particular samples from either, may not have them distinguishable by the naked eye. They in fact abound, in immense quantities, as far as examination has been made, in all river, pond and ocean water, and even in that from wells and springs. Those, however, which are discernible by the naked eye, are usually and perhaps always found, only in water exposed to the light, and where there is a process of vegetation. Those of this description abound in the water of all the London Companies, and particularly in that of the river Thames. They are found also in the water of many of the rivers of this country, from the Charles to the Mississippi, and we doubt not in that of them all. An eminent naturalist and careful observer, Dr. Gould, in reply to inquiries on this subject, lately published, remarks; "The idea of obtaining water from any source, free from animalcules, is vain. I have recently examined some water taken from the issue of one of the springs of pure soft water in South Boston, and there were animalcules in abundance. A friend furnished me a few days since with a small bottle of water taken at the aqueduct house at Jamaica Pond, where the water enters the pipe, and a very short examination detected five different kinds of animalcules, many of them in considerable numbers." The same gentleman remarks upon a sample recently taken from Charles River, a short distance above the Watertown Dam;

"The water you handed me this morning on examination appears to be what we doctors call jaundiced—that is it has a greenish, yellowish tinge, about the color of chlorine gas, probably arising from *Chlorophyle*, the coloring matter of plants, as the water is found by the microscope to be full of incipient *conferva*." "Animalcules of several kinds are detected without difficulty."

Mr. Clark in his testimony before the Parliamentary Commission above referred to, says: "I found the animalcules to abound in the waters of all the companies." It may be remarked that the London companies obtain their supply exclusively from rivers or springs—chiefly from the Thames—and none of them from ponds. Mr. Clark in answer to a question, says: "I speak only of such as I have observed by the naked eye; but it is wonderful how the eye improves in its power of observation, by some practice in watching these animalcules." He says again, "I find these creatures to abound in the New River, and in the waters of West Middlesex and Grand Junction Companies, although these are taken from the river much above any part affected by the sewage of London." Mr. Thom, in the course of the same investigation, stated that he had seen animalcules in the waters of Scotland, discernible by the naked eye, and that he had observed them "wherever the water was shallow and warm."

It is therefore quite useless to expect to obtain water from a source which will be free from these repulsive living beings. The only remedy against them is, to avoid too curious a search by microscopic eyes, and in case they appear, as they will occasionally, of a size to be discernible by the naked eye, to adopt such methods as shall be found practicable, of removing them. That the water of Long Pond is as little infested by them, as that of Charles River, or any other source of fresh and soft water, we entertain no doubt, and independently of other facts, it would be extremely rash to assume the contrary, on so slight evidence as that cited by Mr. Wilkins.

2. *Vegetable and other impurities.*

A far more important question is, which of the two sources is most free from other causes of impurity. The principal of these are the vegetable matter of various kinds, which grows and accumulates within the space over which the water flows, particularly along the margins of ponds, or streams, and the putrid animal and other noxious substances which are discharged into it, from the abodes of animals or men, inhabiting its borders.

Long Pond, and the sources and rivulets from which its waters are supplied, are perhaps more effectually excluded from liability to contamination from causes of either of these descriptions, than any source of equal extent which is to be found, not farther removed from the neighborhood of a dense population. It is more secluded from public highways, and also from dwellings than either Jamaica or Spot Pond. With some slight precautions, to divert from it a small stream, and to dike out certain waters in which there is an infusion of vegetable substances, all which can be done at a very moderate cost, it may be made entirely free from liability to any discharge into it, directly or indirectly, of the waste water or filth, drained or filtered from any manufacturing establishment, barn-yard, or any human habitation whatever; and also secluded from access by any public highway, or private passage way. It is surrounded almost exclusively by a gravelly beach or bank, and in the limited space in which it borders on a peat meadow, it may be separated from it, by a suitable dyke, if found necessary or expedient, at a very inconsiderable cost.

How does Charles River compare in these particulars? It is proposed that the water shall be taken from it at the basin, which is formed by the lower dam in Watertown, on which are situated two paper mills. On the immediate banks of this basin, are dwelling houses on both sides of the river, and also slaughter houses, soap and candle works, and other manufacturing establishments. Into this basin the water is received over another dam, on which are situated Bemis's Mills, the

seat of cotton and other manufactures. At Waltham, three miles only from the spot at which the water is to be taken out of the river for use, is a third dam, on which are situated the celebrated Waltham factories, with all their works for dyeing and bleaching, and also a great variety of other manufacturing establishments. All the waste water, and impure substances discharged from these manufactures; and from the residences of 2500 inhabitants, including the operatives at the factories, are discharged directly into the river, in great part without even the intervention of a common sewer. These of course, go to swell the mass of these fluids, which three miles below, is to be pumped into the reservoir on Corey's Hill, and conveyed thence to Boston, for the daily beverage of its inhabitants.

Mr. Wilkins foreseeing the objections that may be made to the taking of water, where it is certain of being thus constantly adulterated, remarks: "that all such substances only *mix* with water, and do not become *incorporated* with it; consequently *running* water soon clears itself of all such foreign substances." We would ask how it is possible the water should become clear of such substances, in passing along a current of only three miles, and when received from the neighborhood of Bemis's factory, in a single mile. It ought at least, "before taken to be well shaken." There is hardly space for the ingredients to become thoroughly mixed, before being received into the pump, and forced into the reservoir. It cannot be pretended that it will be retained long enough there, to permit impure substances mixed with it to subside, or any natural process to separate it from deleterious mixtures.

Mr. Wilkins relies upon the favorable report of Dr. Jackson, upon the single specimen of this water submitted to him for analysis, as proving that when taken at Wattertown dam, it is found discharged of these impurities, and he remarks, "we are hence authorized to consider this objection as purely one of the imagination." It must be obvious that a single specimen can afford but a very unsatisfactory ground for the inference, that the

whole mass of water of the river is free from either of the noxious substances alluded to, whether animalcules, the offal of slaughter-houses, or the waste water of dye-houses and bleacheries. Frequent examination may show, that although certain specimens may be free from these impurities, they are very palpable to some of the senses at least in others. That the water is liable to be contaminated, by the waste substances thrown off in the process of manufacture, is shown by the following remark in the letter of Dr. Gould quoted by us above. "The numerous fibres in it" he remarks speaking of the specimen taken near the Watertown dam, "betray its source from some of the streams on which cotton factories are located."

The opinion of Dr. Hobbs, the intelligent agent of the Waltham Factory, of the fitness of this water for domestic uses is thus expressed :

"Charles River water is soft and excellent for washing. Goods died from it however become yellow ; we were obliged therefore, at some thousands of dollars expense, to bring spring water in pipes to our bleachery for our last washings. Would not the impurities which the river collects in passing so many manufacturing establishments, be an objection to its use in families? In addition to the waste liquors from paper mills, bleacheries, dye-houses, and other works, it receives its daily contributions from every person employed in the establishments. In a very large stream these additions could never be discovered, but Charles River, in a dry season, is quite a moderate sized stream. Whether it had any sensible effect on the water or not, the idea of drinking it, would not be very pleasant to those who were acquainted with the facts."

The question here put by Dr. Hobbs, is one which those who will have a vote to give upon it, must answer for themselves. We certainly incline to the opinion that the objection is not without force. Although it may be only *a mixture*, and not an *incorporation* of the various substances with the water, it is not a mixture of the kinds of materials most likely to be agreeable to the taste, or conducive to health. Then also its

recommendation "as excellent for washing," is accompanied with a reservation, which to the ladies at least will not seem insignificant. Clothes dried from it, become yellow. There could be no better authority for this fact than that given above. Dr. Gould also says, without knowing whence the specimen was taken, that, "it has a greenish, yellowish tinge about the color of chlorine gas." That it has this tinge at the present season of the year at least, is palpable to the sight of every one who looks at the stream. It probably does not retain it through the year.

Mr. Wilkins, notwithstanding his argument, that the objection arising from these disagreeable mixtures is purely one of the imagination, admits that it has some weight, and that he would "perhaps go to the expense of digging a canal, or even laying in masonry, a common sewer from the Waltham Factories to the Watertown dam." This is a distance of three miles, and the cost of such a sewer could not be less in proportion to its length, than that of the proposed Long Pond Aqueduct, say, \$40,000 a mile, or \$120,000 in all. We find no allowance for this in Mr. Wilkins's estimate of cost. Besides the offal from slaughter-houses, and fibrous substances from cotton mills, which betrayed to Dr. Gould the locality from which his specimen of water was taken, would not be taken off by a common sewer. But this is not all. There is a succession of manufacturing establishments, and populous villages along the whole course of the river and its branches, to their respective sources. At Newton Lower Falls, there are seven large paper mills, which give to the water of the river a large admixture, certainly not of the most agreeable kind, for a beverage. At Newton Upper Falls there is a large establishment of iron works, with a large number of operatives. At Dedham the river receives the waste water of such common sewers as are required for a manufacturing population of from 3000 to 4000. At Dover and South Natick are manufacturing villages upon the banks of the river. Ascending the river still further, there are six cotton factories and several other mills in Medway,

one or two large cotton mills, and a woolen factory in Bellingham, and one or two large factories in Mendon. There are also several cotton and other mills on the Mine Brook, and Mill River branches, besides a great number of smaller mills. This succession of mill powers, to the number of more than fifty, within a distance of that number of miles, is obtained by means of artificial dams, which convert the river from a running stream, to a succession of pools of water, not stagnant, but flowing with a very sluggish current. It is thus made to flow, during certain portions of the year, over thousands of acres of sunken swamps and meadows, and lands covered with vegetable matter of various kinds, as prolific of vegetation and animalcules, as any collection of water which can be found. The infusion of these substances gives the water its high color, and the putrid and other noxious substances in addition, which the river conveys to the ocean, by being made the main trunk, through which the residences of so large a population are drained, must certainly deprive it of that quality of peculiar purity, which can recommend it as a proper aliment for a large population, who have the alternative of a resort to another source of supply, free from exposure to all these repulsive mixtures.

These are the facts, as to the comparative situation, and exposure to contamination, of the waters of these two sources. But the true test, of at least a part of the properties of the water, is actual comparison. This every man interested in the question, may make for himself, and he may thus form his judgment upon the evidence of his own senses. This is what the writer of this has repeatedly done, and he entertains no doubt whatever, of the superior purity of the water of Long Pond, over that of Charles River, and its similarity, in all its substantial qualities, to the waters of Jamaica Pond or Spot Pond. It is, however, in some seasons of the year, slightly tinged in color, (though far less than the water of Charles River) from causes which may be probably removed, in the manner suggested above; if on investigation it should be found an object

worthy of attention. It proves also, on chemical analysis, to contain in a very small degree, a larger proportion of earthy matter than the water of those ponds. This may be found to proceed from its flowing over a portion of swamp, from which it may be found expedient to exclude it. But taking the water in its present state, flowing as it does over a larger surface, and to a higher level, than that recommended by the Commissioners, it is comparatively a remarkably pure water, and Dr. Jackson, who has made repeated analyses of specimens of it, some of them recently, remarks that, "the foreign matters in this water are in such small proportions, as in no way to impair its healthfulness as a drink, nor will they prove injurious in washing clothing."

IV. STRENGTH AND DURABILITY OF THE PROPOSED AQUEDUCT, AND THE SUFFICIENCY OF THE ESTIMATES.

1. *Novelty of the Proposed Structure.*

The next objection to the plan of the Commissioners, is the "frail and unsubstantial" structure on which it is to depend. Mr. Wilkins says :

"In this construction there is novelty, as far as my inquiries have extended. I can find no example where a structure so frail and unsubstantial has been relied upon to perform so important service; and for myself I hope I shall never see it relied upon. If the Long Pond scheme is to be executed, let it be done on a plan less liable to failure, less liable to perpetual patching and repairing, than this project contemplates. But even at the best, a structure like this, if executed in the most substantial manner, like the Groton works, is much less secure than one of iron pipes."

Here are propositions which imply that in the opinion of the writer, the Commissioners are the greatest ignoramuses who were ever employed to recommend a plan of public works. We can assure him that the plan of construction is not entirely novel; that repeated experience has proved, that it is far from being frail or

unsubstantial. If it is liable to require patching or repairing, it is an objection which should be founded on proof of the fact, of which none has come to the knowledge of the Commissioners, although they have known many works constructed on this principle. The structure, taking into consideration its comparative size, is demonstrably stronger than that of the Croton aqueduct. The top and bottom arches, although of two thirds only the span, are of the same thickness as the top arch of the Croton, and they are to be built of the same materials. The lateral pressure as well as the downward, is resisted by the arched form of the side walls. In regard to the comparative security of the Croton aqueduct, and of iron pipes, whatever opinions may be entertained of it, by those who have never seen the former, engineers of experience, as well as other persons of competent judgment, who have thoroughly examined the structure of it, and the materials of which it is composed, as well as the effect of water upon them for a period of some years, are satisfied, not only that it is as secure and durable, as an aqueduct composed of iron pipes, but that any additional work, for making it more substantial, would have been a waste of expense.

In regard to the novelty of the proposed Long Pond structure, it is in our power to state, that when the plan of it was explained to the intelligent resident engineer of the Croton works at New York, he expressed his opinion of it, by referring to drawings made by him, for the large sewers, in conformity with which, the Street Commissioners are now laying the sewers of that city. They were of cylindrical form, six feet in diameter, of two courses of brick in thickness, and to be laid upon the earth, as excavated for the purpose, without other foundation. If such a structure is of sufficient strength to sustain the unequal pressure of all descriptions, which will come upon a sewer, at all the varieties of depth in a public street, liable to be traversed by heavy loads, it is certainly sufficient to sustain the external pressure of earth, as

well as the internal pressure of four feet in depth of water, in an aqueduct like that here proposed. We find also, in a volume of documents published by the Board of Aldermen of the City of New York, which happens to be in our possession, an extract from a contract by the Street Commissioners, for the construction of a sewer in the Sixth Avenue, which is to be "one thousand seven hundred and fourteen feet in length and to form a circle or cylinder of six feet inside the clear, and the wall to be eight inches in thickness."

In the City of Philadelphia, sewers on a similar principle, have been introduced within a few years, to a larger extent, under the direction of the most distinguished and experienced engineers. Any one who has within that period visited the city, must have observed the obstructions in the streets, during the carrying forward of these works. These sewers are of a cylindrical form, they are built of brick, eight inches in thickness, and some of them are ten feet in diameter. We have observed in one of the journals of that city, a notice of these works, which is introduced with the remark, that probably the extent to which they have been built is known to but few of the inhabitants. It is stated that they have been constructed under the streets of the city proper, to the extent of ten miles. The following additional particulars are given of these works, from which it may be inferred that they are fully relied on, for strength and durability.

"Of these sewers, the contents of eight miles are discharged into the Delaware, and four miles into the Schuylkill. They are chiefly constructed of bricks, in shape cylindrical, and varying in size from three to ten feet in diameter, lying from three to thirty feet in depth below the surface of the pavement, according to the situation of the ground to be drained. All the main trunks required for a complete system of drainage throughout the city are completed, and the smaller branches, of three and four feet in diameter, are extended to points where too much water accumulates to be carried off in the gutters."

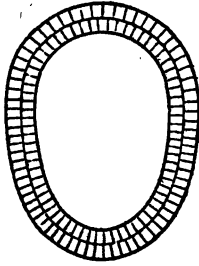
These authorities go only to the fact of the novelty of a *cylindrical* work. The *oval*, or egg-shaped form differs so little from this, and the superior advantages of it in point of strength, and available capacity, for the object to be attained, are so obvious, that a precedent or authority to justify the deviation would seem hardly necessary. Yet both these are at the service of those, who are not satisfied with the judgment of the Commissioners, in their recommendation of this deviation. In the Parliamentary examination repeatedly referred to above, four eminent Civil Engineers of Great Britain, were questioned expressly upon the point of the form of sewer, which is strongest and best adapted to its object. Mr. Guthrie said, "I think the form adopted by the Holborn and Finsbury Commissioners is the better form," viz., "the egg-shaped." "The greatest strength is by that form secured." Mr. William Hoskins, Professor of Architecture in King's College, says, "I think the best form to be that of the longitudinal section of an egg." Edward Cressy, Esq. an engineer of 30 years practice, says, "my impression is that the form which would nearest approach an egg-shape, would be the preferable one. There is more economy in it, and greater strength." He explains by saying that "greater strength is obtained for resisting the lateral pressure, by having curved instead of straight sides."

2. *Comparative strength of the proposed form of Aqueduct.*

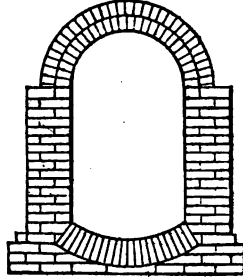
B. Williams, Esq. Professor in the College of Civil Engineers at Putney, expressed the same preference, on the ground of strength and economy, and illustrated by diagrams, of which several are given in the printed testimony from which these facts are quoted. The annexed cuts are copied from two which are given in his testimony, for the purpose of illustrating the superior strength of the Finsbury Sewer, on account of its curved sides and base, over the Westminster, although the latter is of greater thickness,

requires a much greater quantity of bricks in its construction, and is of greater cost.

FINSBURY SEWER.



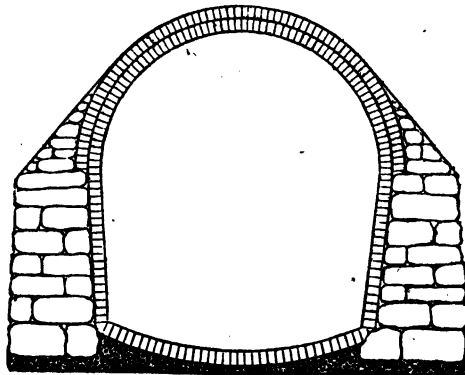
WESTMINSTER SEWER.



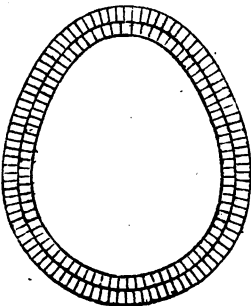
The interior height of the Finsbury Sewer, of which a section is here given is 5 feet 3 inches—its width 3 feet 6 inches and it is built of brick laid in common mortar, of the thickness of two bricks in width. The Westminster sewer is 5 feet 5 inches in height, 3 feet in width, with side walls of the thickness of three courses of bricks, with an arch at top of two courses. The witness knew of repeated instances in which the latter structure had failed for want of sufficient strength in the straight sides, he stated that he had recommended the former to be substituted, which he had never known to fail.

The subjoined cuts show a section of the proposed Long Pond aqueduct, and that of the Croton, both drawn on the same scale as the above, viz. five feet to an inch.

CROTON AQUEDUCT.



LONG POND AQUEDUCT.



The object in exhibiting these comparative illustrations is to show, from the example of the Finsbury structure in comparison with the Westminster, that the Long Pond structure has a similar advantage of form in comparison with the Croton, in the curved sides over the straight, so as to render superfluous the increased strength given to the latter, by the addition of stone masonry, in support of the brick. It will serve to show also, what practical men will hardly deny, that the form of the base, when resting in cement directly upon the earth in its natural state, is as well adapted, at least, for resisting pressure in any form in which it can come upon it, as any which can be proposed. We do not of course question the abundant strength of the Croton structure, nor give any opinion of its comparative strength, for a work of the same dimensions. Our object is to show, that the support given to the Croton side walls, by the addition of external walls of stone, is rendered obviously unnecessary, especially for a structure of the size proposed in the Long Pond work, by the change in its form. If any one doubts its sufficiency, it is incumbent on him, in urging that doubt upon the public, to support it by some other reason than that of its novelty.

3. *Cost of the proposed Work.*

Mr. Wilkins does not call in question the sufficiency of the Commissioners' estimates of cost of the work, although he thinks the allowance for damages which will be demanded for taking water, too low. Mr. Shattuck, however, says, that "we are certainly not warranted in supposing, from any evidence yet produced," that the work can be built for a cost any thing like the estimate. "There is," he says, "*no doubt in my mind*, that the cost, *if the work is done as it ought to be*, will not be less than \$4,000,000, and may amount to \$5,000,000."

Some evidence surely has been produced, in support of the estimate of the Commissioners, but we have looked in vain for any in support of that of Mr.

Shattuck. He has "no doubt" that the cost will be double the estimate, and it may be more. His opinion without reasons, is perhaps of as much weight, as if his reasons and authorities were given. Mr. Derby also in behalf of the remonstrants against the city petition, in his argument before the legislative committee, maintained that if the work recommended by the Commissioners were entered upon, "it would be equal to throwing away $4\frac{1}{2}$ millions of dollars, which would increase taxes in the city 40 or 50 per cent."

In support of this position, Mr. Derby went into a calculation, to prove that the actual cost of the Long Pond plan, with that of distribution in the city, instead of \$2,118,535, as estimated by the Commissioners, will be \$4,820,143—and fully sustaining Mr. Shattuck's opinion mentioned above. This calculation is worth a little examination. 1st, he takes the cost of distribution, at the estimate of the Commissioners, without addition. So also the cost of introduction from Corey's Hill, and all the pipe work, he takes at the same estimate. Those items embrace more than half the entire estimate. He could not safely add to these branches of the estimate, because in the works from Spot Pond, consisting of an aqueduct of iron pipe, which he recommends as a substitute, the cost is estimated by him at a much lower rate. For example, if the Spot Pond work be adopted, the whole cost, distribution included, will be, according to Mr. Derby, but \$492,712. It is astonishing to observe, how much more cheaply, in his opinion, Spot Pond water will flow, than that of Long Pond. The Commissioners' estimate of pipes, for bringing the water from Corey's Hill, to Beacon Hill, a distance of four miles, is \$340,000. Mr. Derby's estimate of introducing water from Spot Pond is, "7 miles of iron pipe at \$28,000 per mile, \$196,000." It is true the Spot Pond work is not calculated for the introduction of the same quantity, but Mr. Derby gives no credit for this difference. Again; the Commissioners' estimate for distribution of Long Pond water in the city is

\$672,767; Mr. Derby's estimate for distribution in Boston, of the water of Spot Pond, is \$174,712. Here again no allowance is made by him for the increased quantity of water to be distributed, and the greater extent and completeness of the distribution. On the other hand he takes credit for greater security against fire, to be derived from the Spot Pond water, on account of the greater height of the source, although, as has been shown, the point at which the works are adapted to deliver the water in Boston, is seven feet higher in the Long Pond plan, than in the Spot Pond.

There remains, then, of the Commissioners' estimate, after deducting the items not objected to by Mr. Derby, others amounting to only \$825,000 which are magnified by his inflating process, into the enormous excess above stated, which has so much alarmed the remonstrants against this work. What we are about to state we hope may relieve some of these apprehensions. We wish it to be particularly noted, that of the whole estimate of the Commissioners, which is thus confidently pronounced too small by one half, and which it is predicted by Mr. Derby will be more than doubled in the execution, so as to entail a dead loss on the city amounting in 20 years to 12 millions—more than half the items in amount, are substantially admitted to be sufficient. The items thus admitted to be sufficient are those which are most uncertain—amounting to \$1,100,000, and including the whole cost of distribution and expenses in the city. The sufficiency of these is in fact more than admitted, by the attempt to establish another work in preference, founded on estimates at a much lower rate.

How then is the insufficiency of the remaining estimates made out by Mr. Derby? They consist chiefly of three items—the brick aqueduct, 16 miles, \$450,000, the excavation, embankment, and back filling, \$180,000, and water rights and land damages, \$121,000. Out of the insufficiency of these three items, with the addition of interest, Mr. Derby manufactures his estimate of additional cost, amounting to \$2,700,000.

To begin with the brick aqueduct; Mr. Derby estimates this at \$100,000 a mile, which he says, "is cheaper than the Croton was built." Here Mr. Derby must have been misinformed. The amount of masonry in each mile of the Croton work, according to the statement of Mr. Jarvis, the Chief Engineer, is as follows:

Concrete masonry,	-	900 $\frac{1}{2}$	cubic yds.	
Stone in Side walls,	-	4218	"	
" in Spandrels,	-	527	"	
<hr/>				5,645 $\frac{1}{2}$
Brick in arches and facing,	-	"		2,671

The contract prices of 50 sections of the Croton work, making more than half the work, according to a statement in our possession, (and of the other sections we have no information) average for the concrete and stone work about \$6.25 per cubic yard, and for the brick \$11.13. This makes for the former \$35,284; for the latter \$29,728. Total, \$65,012 per mile, instead of \$100,000.

- Besides, Mr. Derby must have been aware,—even should it be found necessary, by the commissioners and engineers to be entrusted with the execution of the Long Pond work, to construct it in the same manner, with brick and stone masonry, as that adopted in the Croton,—that an aqueduct adapted to the supply of 7,000,000 gallons, of an internal sectional area of 24 $\frac{1}{2}$ square feet, could not cost as much, by some 30 or 40 per cent., as a work calculated to supply 59,000,000 gallons per day, having an internal area of 53 $\frac{1}{2}$ feet. The diminished size of the whole would render a less thickness of side walls necessary for giving adequate strength, and the diminished height of the walls, and lessened span of the arch, would of course deduct much from the aggregate of masonry. If we reduce the above amount by a third, it will leave the cost per mile, based upon the cost of the Croton, supposing the same kind of structure necessary, \$43,340, instead of \$100,000, as Mr. Derby supposes.

But it is entirely unnecessary, as we believe we

have satisfactorily shown above, to strengthen the proposed brick walls, provided they be laid in the cylindrical or oval form proposed, by any addition of stone masonry. The estimate, therefore, of the amount of masonry, by the commissioners, may be assumed as sufficient, until some authority is given for a contrary opinion. The guesses of Mr. Derby and Mr. Shattuck, without calculation, and without any pretence of knowledge of details, are not sufficient to overturn an assumption, founded on careful calculation, by men appointed for the duty, on the belief that they had some knowledge, or at least the means of acquiring information on the subject in question. This estimate is 2,594 cubic yards of brick masonry per mile of aqueduct. This quantity, at \$11.13 per cubic yard, the average rate of 50 sections on the Croton aqueduct, makes a cost of \$28,860 per mile. Taking, therefore, the actual cost per cubic yard, of brick arched work laid in cement, on the Croton aqueduct—a cost believed by the engineers who directed that work, to be at least 10 per cent. higher than the same work would now cost, as the standard by which to estimate the cost of the Long Pond aqueduct—it produces an amount far from \$100,000 per mile, and only \$726 more than the estimate of the commissioners, which is an average of \$28,134. Aside from all this calculation, we will venture to say that there is no mechanic in Boston or the vicinity, who knows any thing of the value of such work, who will seriously maintain that the estimate of the commissioners, viz: \$16 per 1000 of brick, laid in cement—that is to say, \$10 for the brick delivered, \$3 for the work, and \$3 for cement and other expenses—is not sufficient.

4. *Estimate of Excavation and Embankment.*

We come next to the item of excavation and embankment, “including earth and rock excavations, and back filling over brick work, and valley pipes, \$180,674,” viz. in round numbers, excavation and embankment, 888,000 cubic yards, at 17 cents, \$151,-

000 ; back filling 90,000, at 10 cents, \$9,000 ; and rock excavation 14,000 yards, at \$1.50, \$21,000. In lieu of this, Mr. Derby's estimate is, "excavation and embankment, \$400,000, back filling, \$100,000." He says that the commissioners' estimate is too low, and that no allowance is made "for the extra cost of back filling, coffer dams, and pumping out of water, which would be required in the course of the work." How does Mr. Derby know this? The account which the commissioners have given of this matter, at page 22 of their report, is in these words: "The whole excavation and embankment, including the embankment for covering the brick aqueduct, [which in the New York estimates is included in *back filling*,] except where it is covered by replacing the excavated earth, is estimated at the price of 17 cents per cubic yard. The *filling of the cuttings*, by replacing the earth, is estimated at 10 cents per yard." How does it appear that there is no allowance for "extra cost of back filling," or for coffer dams, and for pumping out water, if it should prove necessary? Is not 17 cents a yard a sufficient estimate to cover some slight contingencies of this sort? Mr. Derby, to make up his computation of the cost of this work, must either deny the correctness of the surveys, or of the computations of excavation and embankment, relied on by the commissioners, or he must compute it at much higher prices. It is difficult to imagine how he can have gone on the former hypothesis, for he has never inquired what the surveys or computations of the commissioners were, nor, so far as we are informed, have any other surveys been made, on which other computations could be founded. He could not of course dispute the correctness of a mathematical computation, without knowing what it was, nor substitute another without some specific data, obtained by actual survey, on which to found it. Carrying out his estimate, therefore, in the detail, apportioning it to the several items according to the ascertained quantities of each, it must be something like the following.

Earth cutting and embankment, 888,000 yards, at 39½ cents,	351,000	
Rock cutting, 14,000 yards, at \$3.50,	49,000	
		400,000
Back filling, 90,000 yards, at \$1.11,		100,000
		<u>\$500,000</u>

It is only by adopting these extravagant prices, that we can make out his amounts. If we adopt the supposition that Mr. Derby, instead of making up his enlarged estimate by these exorbitant prices, and that he would apply to the excavation and embankment here, the same price which he insisted in a hearing before another legislative committee was sufficient in rail road work, where the earth excavated is required to be carried into embankment, viz., 11½ cents per square yard, instead of 39½, we must fill out his estimate something in the following manner.

Earth work, by computation, 888,000 yds.		
at 11½ cents,		102,000
Rock work, " 14,000 "		
at \$1, - - - - -		14,000
Back filling, " 90,000 "		
at 11½ cents, - - - - -		10,350
		<u>\$126,350</u>
Supposed blunder in computation of the commissioners, 1,000,000 yds. at 11½ cents,		115,000
Supposed concealed rocks, not yet discovered, 10,000 feet long, and 27 feet deep, 100,000 cubic yds. at \$1,		100,000
Extra back filling, should it be found necessary, 780,000 cubic yds. at 11½ cents,		89,650
Coffer dams and pumping, to balance,		69,000
		<u>373,650</u>
Total corrected estimate, as above,		<u>\$500,000</u>

5. Estimate of Water Rights and Land Damages.

There remains the estimate of water rights and land damages. The commissioners' estimate is \$121,600, Mr. Derby's \$400,000. We shall not waste words in arguing against this extravagant estimate. If

there is any one so credulous as to believe that the diversion of a water course of so moderate dimensions as this, affording, without the aid of artificial improvements yet to be made, a constant flow, not exceeding, during a portion of the dry season, two to five feet a cubic second, can be productive of damages to this amount, they must be beyond the reach of influence from facts or arguments.

Mr. Knight, who owns the outlet of the pond, and who consequently possesses the right of improving and enlarging the constant mill power, by confining the water in wet seasons, and reserving it for use through the whole season, has doubtless a valuable property in the pond. The worth of this property it cannot be very difficult to estimate, by comparing it with what like mill powers are worth in other places, or with the cost at which a substitute for it in steam power can be afforded. The water of which the Middlesex canal, and the other claimants will be deprived, during those periods of the year in which it can be of any value to them, we have no doubt can be supplied to them by means of artificial reservoirs, on some of the tributaries to Concord river, at a cost within the estimate of the commissioners. That the damages from the diversion of this water are likely to amount to \$400,000, is one of those assertions which are easily made, but which it is difficult to prove, and as difficult to credit in the absence of proof.

Finally, Mr. Derby further swells his estimate, by adding to it ten per cent. for contingencies, on the gross amount produced by thus doubling the commissioners' estimate, and by a still further allowance of 20 per cent. for five years' interest on the whole amount, from the date of the expenditure to the commencement of an income upon it. The amount of these two items is \$1,168,000; a fit climax to such a series of baseless exaggerations. We confidently deny that there was a particle of evidence in the whole course of the examination before the committee, to give a plausible pretext in support of one of them.

6. Conclusion.

We conclude these remarks by recapitulating the leading propositions which we have endeavored to establish.

1st. That the introduction of water into the City, is a measure of urgent necessity, for meeting the wants of many families, who are entirely dependent on the precarious supply which falls from the clouds ; and also for the security of every part of the city against imminent hazard of conflagration. But the extent of this absolute want, forms a very inadequate measure of the urgent demand arising from the UNIVERSAL WANT of *pure and soft water*, fit for washing. Those who are best supplied with soft water, depend for it on the precarious source above mentioned ; and such is the adulterated state in which they obtain it, under the most favorable circumstances, that a convenient supply of really pure and soft water, is a luxury entirely unknown in the City.

2d. It is expedient that it should be introduced at the charge of the City, so that the inhabitants may have an ample supply, and may have it for all purposes, public and private, *at the cost of introducing it under the most favorable circumstances*, and not at such a price as will pay a profit to private companies for the investment of capital, and for the risk of losing the whole either by competition with one another, or by future competition from the City itself.

3d. That when finished in this way, the annual cost of the most liberal and abundant supply, will be less than the charge of interest and repairs, in maintaining wells and pumps, for the present imperfect supply of hard water for drink and food, and of cisterns and pumps, for turbid and smoky rain water for washing.

4th. That although where great economy in the use of water becomes a matter of necessity, the consumption may be limited to a comparatively small quantity—whenever it is supplied in an abundance, which leaves every family unrestricted, and admits of

the free use of it, for watering the streets, and for manufacturing purposes, a far greater quantity is demanded, than enters into the calculations of Mr. Wilkins, Mr. Shattuck and Mr. Eddy. This is proved by the experience of other cities, both in England and in this country. In taking the example of the supply of foreign cities, as a criterion by which to judge of the demand here, allowance is to be made for the style of independence and comfort, in which the mechanics and most numerous classes of inhabitants in this City live, compared with that of the most numerous classes of population, in the manufacturing towns of England and Scotland. For this reason it is more safe, in adopting a standard by which to estimate the rate of supply, to resort to some city where the water is paid for by those who use it, and where the habits of domestic life, and the industrial pursuits, are similar to those of our own citizens. Such an example is before us, in the city of Philadelphia, where a system of supply has been in operation for the last 25 years, which, from its perfection has been the envy of all other cities, and where, fortunately, the actual quantity supplied is accurately measured, or computed, every year. This quantity, in proportion to the population of the two cities, we propose to adopt as the basis of the computation for our own supply. To proceed upon the assumption, that a materially less quantity than that indicated by this mode of computation will be sufficient, we insist would be an extreme of folly, which the citizens of Boston cannot be suspected of committing.

5th. We assume upon these grounds, that a constant supply, of not less than an average of 4,000,000 gallons per day, should be provided for the present demand, and of not less than 7,000,000 for meeting the prospective wants of the city; and further, that any system of pumping which can be devised, either from Charles River or from Mystic Pond, would be more expensive, even if limited to the smaller quantity, than to introduce the larger quantity, by a durable brick

aqueduct from Long Pond. In the meantime, until the increase of population shall be such, as to demand the use of all the water so supplied, there will be a surplus for fountains, for the embellishment of the Common, and other public places, or to be applied to any other valuable use, for which it may be demanded.

6th. That the natural properties of the water of Long Pond, as judged of by the eye, and by the taste, as well as by chemical tests, entitle it to be ranked with the purest class of waters; and from the secluded position of the source, removed as it is from human habitations, the resorts of animals, and public streets, it is the least likely, of any that can be selected, to be adulterated by the mixture of deleterious substances. On the other hand, the water of Charles river which is recommended by Mr. Wilkins in preference to it, acquires during a part of the year a deep color, from the extensive meadows and swamps which are overflowed by it, and it is liable to constant disgusting impurities, from washing the borders of so many populous villages, and carrying off refuse substances from various manufacturing establishments.

7th. The estimate of the Commissioners, of the cost of the Long Pond aqueduct, has stood the test of investigation, during a hearing of 25 days before the legislative committee, notwithstanding the desperate effort to double it. More than half the items of it in amount were admitted by its opponents to be sufficient, because they had rival projects depending on estimates for similar works at lower rates—and the other half were assailed by no other argument, than that other estimates, of other works, by other persons, have proved insufficient, and therefore this must, and that the Croton aqueduct was asserted to have cost \$100,000 a mile, and accordingly the Long Pond aqueduct must cost at the same rate. As we think we have shown that these arguments prove nothing, and as in spite of them, over half the estimates are admitted by the opponents to be sufficient, we shall assume it for a fact, that the attack on the estimate is a failure.

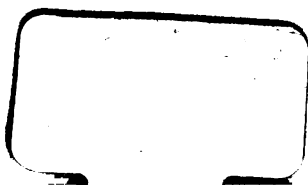
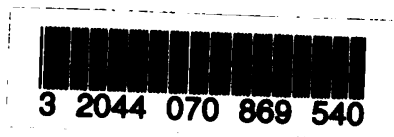
6th and lastly: If the citizens of Boston adhere to the opinion which they have repeatedly declared, that they want water---if they wish it introduced on their own account, so that they may have it at the cost, instead of paying a profit upon it, to a private corporation, and so that it may be under the exclusive control of their own officers---if they wish it, as they declared by their vote of December last, from Long Pond, a source never suspected of impurity, during a period of seven years' investigation, until the discovery by Mr. Wilkins of the horned animalcules, which are equally abundant in all other waters---if they wish to have the water introduced in their own life-time, and not for the exclusive benefit of their posterity---they will vote for the acceptance of the act, which authorizes the introduction of the water of either Long Pond or Charles river, at the election of the city council.

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